Medical Reſearches.

MEDICAL RESEARCHES:

BEING

An ENQUIRY into the NATURE and ORIGIN of HYSTERICS in the FEMALE CONSTITUTION, and into the Diſtinction between that Diſeaſe and HYPOCHONDRIAC or Nervous Diſorders.

COMPREHENDING

A Specification of the characteriſtic Refinement and Excellence of the FEMALE CONSTITUTION and CHARACTER. A Reſearch into the Materiality of theſe Occult Powers and Principles of Activity commonly called LIFE, in the Human Frame.—Into the real Exiſtence of an Image of our whole Organical Frame, in the Seat and Fountain of its Powers, and the phyſical Probability of there being a Regeneration of that Image in Organs formed for the Tranſfuſion and Multiplication of Individual Life.—The true Nature, Symptoms, and Indications of Cure of the HYSTERICAL Diſeaſe.—The Abuſe of Sugar, as a Cauſe of its encreaſed Frequency, and the encreaſed Frequency of Infant Mortality.—The preciſe Seat of Animal Heat.—The Structure of the Blood.—Practical Hints, relative both to the Hyſterical and Hypochondriacal Diſeaſes, and the Management of them, &c. &c.

TOGETHER WITH

The SUBSTANCE of a DISCOURSE, proving that the Motions of the Blood and Animal Fluids do not depend on the Impulſes of the Heart upon the Blood, but muſt be referred to other Cauſes, and particularly to an Animal Modification of that univerſal Principle which is the common Cauſe of all Organiſation, and of all organical Motions in Bodies.

TO WHICH ARE ADDED,

FOUR LETTERS to SIR HILDEBRAND JACOB, on the MATERIALITY—DENSITY—and ACTIVITY of LIGHT; and on AIR.

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THE AUTHOR

TO

THE TRULY LEARNED

AND

MOST RESPECTABLE BODIES

THE UNIVERSITIES OF

OXFORD and CAMBRIDGE.

I SHOULD account myſelf guilty of a very great violation of the high reſpect I both owe and pay to the two moſt diſtinguiſhed ſeats of learning and nurſeries of ſcience in the world, to invoke their attention or regard to any ſmall medical tract of a private nature only.——I confeſs the title of this little piece does not beſpeak it ſuch as to claim either the acceptance or patronage of two ſuch venerable ſeminaries of univerſal ſcience, whoſe honourable province it is to plan out, and rear the whole fabric of learning, upon the moſt ſolid foundation, and of the moſt ſubſtantial materials.—May the edifice ever flouriſh and never decay among your hands!——But you will readily diſcern that the title of theſe diſcourſes is in a great meaſure uſed as an occaſion to throw what Light I can into the obſcurities of a ſubject, which tho' connected with my profeſſed deſign, is in reality of a much more comprehenſive nature, referring not only to the principles of medicine, but to thoſe of philoſophy itſelf: And tho' my introducing theſe views, may appear in this work as ſeeming aberrations from its title, You will alſo diſcover in the work itſelf ſome apology both for my retaining the title affixed to it, and for connecting with it matters I could not have diſcourſed of by themſelves; without a great deal of enlargment and expence of time.

I CANNOT perhaps explicitly expreſs what would be neceſſary to point out the importance of the views contained in the following ſheets, without ſeeming to arrogate ſomething to myſelf that may be judged neither becoming nor due to me. But, in ſhort, my intention is to introduce and recommend to more attentive obſervation, the greateſt in point of quantity, and at the ſame time, the moſt important material part of our conſtitution; which ſeems in a great meaſure hitherto, to have eſcaped the notice of the learned, in all the analyſes that have been made of it.

I DO not mean to ſay, that their reſearches have been carried on without the greateſt penetration and ſucceſs, where-ever they have directed their attention; with incomparably more indeed than any I can promiſe to ſatisfy my readers with, on that particular part of our compoſition; which, nevertheleſs I cannot help fixing upon, as the primary, the direct and the ultimate principle of vitality, and of every property in us, that contributes to it.

The old phyſicians of the Galenical and Peripatetic ſchools ſatisfied themſelves with the four elements, the four occult qualities, and the four temperaments generated out of theſe, with which they tempered up the known materials of our frame, ſo as to ſatisfy their own ideas of all its various operations and functions.

When theſe were diſcovered to be inſufficient (unjuſt I cannot call them, ſo far as they went) for erecting a Scientific ſyſtem of medicine upon, the aſſiſtance of mechanical philoſophy, when it was revived, was engroſſed to aſſiſt in carrying on the work; and beſides the general laws of Gravitation and Attraction, the laws of Mechanics and Hydralics became applied to the animal ſyſtem, and had aſſigned to them their ſhare of the work; and as new phœnomena, diſtinctions, and terms for them, occurred in the philoſophical reſearches of the learned, theſe came all in their turn to be engroſſed alſo into the ſyſtem of human nature: elective affinities, electricity, animal irritation, ſpaſm, fixable air, and laſt of all, Life, as a principle, took their ſhares, or rather their ſucceſſive turns as reputed cauſes of the phœnomena that appeared in the animal ſyſtem.

THE greateſt objection that can be made to this fluctuation in phyſiology is, that as new principles came to be aſſumed, former ones were forgoten and neglected; as if their efficiency ceaſed immediately, like old miniſters in a ſtate, upon the introducing of new ones. If ſucceeding enquiries both in philoſophy and phyſiology, had retained in their view the placita of their predeceſſors, as circumſtances not to be loſt ſight of or neglected, tho' not to be aſſumed as principles, the Faculty would have attained the end of their enquiries more certainly, than by being ſo intent on their own diſcoveries, as to neglect as rubbiſh, all theſe circumſtances that were formerly of ſo much moment.

I HAVE often been ſurpriſed at the ſhort-ſightedneſs of philoſophers in this reſpect, who by ſuch a procedure have often rowed themſelves back again into the port they ſet out from, when they thought themſelves landed on the coaſt of a *Terra Incognita.*

WE have an eminent inſtance of this in the preſent phyſiology. Nothing has been long thought more contemptible in the old theory of medicine, than the doctrine of the four occult qualities. We have made a long voyage from that port, through all the mechanical and other principles of modern philoſophy; we have touched at the fortunate iſlands of electricity, irritability, fixed air, ſpaſm, &c. and at preſent, we are landed again at heat, an occult effect of life, an occult principle, reſident in the animal ſolids.—Is this any thing different from heat, one of the four occult qualities? When it becomes even a doctrine of the ſchools, that animal ſolids, in conſequence of eſculent matter becoming ſuch, poſſeſs heat as a quality, and other new unknown properties, which the matter they are formed of contained not before; it becomes highly requiſite to pay ſome attention to that eſſential part of our frame, capable of diſplaying all theſe ſuppoſed principles, which has lain ſo long in obſcurity.

WITH all the extravagance and abſurdities of the alchymiſts, and the other firſt cultivators of chymiſtry, they are the only ſect of phyſicians, who ſeem to have extended their views to that elementary part of our conſtitution, which only can diſcharge all theſe phœnomena and functions in it that have been reduced to laſt principles, only becauſe our extent of knowledge in mechanics cannot ſolve them.

ALL their viſionary projects for obtaining the philoſopher's ſtone, the alcaheſt, univerſal menſtruum—the univerſal medicine, &c. proceeded upon at leaſt a rational preſumption, that every ſubſtance in nature had a ſeminal origin, or was generated out of materials ſo animated, as to act upon other proper ſubſtances, by aſſimilating them to its nature. This ſeminal virtue, they ſuppoſed lay in an animation of the materials they wrought upon in ſuch a manner, that the elementary anima they propoſed to introduce into, and fix in it, ſhould act ſo as to reduce proper ſubſtances preſented to it, into the ſame organization and ſtructure with the ſeminal ferment.

WHETHER any of theſe philoſophers ever made gold or not, or whether it lies within the compaſs of art to generate a ſeminal virtue of any kind in matter or not, is not the queſtion: yet, certainly, they philoſophiſed juſtly in ſuppoſing that all formal bodies were generated by a ſeminal virtue, and in ſuppoſing that that ſeminal virtue lay in the animation of bodies ſo as, by the ſubſtance of fire, to qualify it, in ſuch organs, to aſſimilate other terreſtrial materials under proper circumſtances into their character; in the ſame manner as, in the animal œconomy, blood carried into bones becomes bone, into cartilages, cartilage, into fleſh, fleſh, and into ligaments, ligament.

The moſt excellent Boerhaave, who underſtood well the doctrine and principles of the alchymiſts, in his Analyſis of Fire, has outdone all others in his endeavours to eſtabliſh the univerſality and importance of this element, and to ſtrip it of its myſtic dreſs. It would have been impoſſible for philoſophers ſince, to have thought of introducing an æther, or an electrical fire of unknown origin and properties diſtinct from this, or to have reſolved ſo many of its ſubtile effects into immaterial virtues accreſſing to bodies, and adyta of natural ſubſtances, which it was profane to look into, or to attempt to interpret or refer to that matter, and theſe powers of it, which may be perceived to preſide in and over all natural things.

Though the moſt obvious phœnomena in nature tend to aſcertain beyond doubt, that the matter of common light or fire pervades all nature, and fills all things; yet the whole has been overlooked as an accidental filtration that implied no conſequences, nor interferred with the various unintelligible properties of bodies, which they poſſeſſed independent of it, notwithſtanding its inevitable acceſs to their innermoſt penetralia.

It is evident, that the natural omnipotence of light depends on the ſun. By him, in a natural ſenſe, the matter of light, or of fire as his iſſue, is omnipreſent and all-ſufficient. If the life of all things depends on the activity he communicates to them; muſt not, then, that be the very influence that generates and maintains that life in all its ſpecific characters, in every being according to its kind?

This globe is only an accumulation of terreſtrial materials introduced into this boundleſs ocean of ſolar fluid, for a theatre on which to diſplay its inexhauſtible energy and powers, in conſequence

quence of the maſs being ſo diſpoſed and arranged by its Author, as to become a ſeminal bed of materials for it to pierce, animate and diſplay an endleſs variety and ſucceſſion of beings and life in. Without any ſimilar forms or properties in itſelf, this fluid is capable of extricating all the forms, and generating all the powers of nature out of the materials provided for it to poſſeſs.

It is this fluid that in ſome parts of the following diſcourſes, I mean to point out, and recommend to the attention of every candid and diſcerning enquirer, as that part of our ſubſtance which is the real material ſubſtratum of the univerſal properties belonging to us as terreſtrial matter; of the generical properties that conſtitute us animals, and of the ſpecific ones which characterize us human creatures. This ſubſtance, I apprehend, it is that impreſſes and feeds the diverſified ſimilarities of the different parts of our compoſition, and the characteriſtic ſigns and marks of our individuality; while by a virtual concurrence and ſubtiliſation of all theſe in the ſeat of conſciouſneſs, it generates our ſenſes, our paſſions, our habits, our volitions, and the powers ſubſervient to them; in ſhort, that whole focal concentration of life correſpondent with every part of our form, whoſe inceſſant energy ſupports every vital, natural and animal function in our conſtitution.

THE diſcourſe on the cauſes of the circulation of the blood is ſo neceſſarily connected with the ſame ſyſtem of views, and tends ſo directly to illuſtrate the neceſſary acceſſorineſs of this vital element of our conſtitutions, to the diſcharge of that important work, which, hitherto, generally, the mechanical ſhocks and impulſes of the heart, and of arteries, have been deemed ſufficient to execute, that I judged the annexing of the ſubſtance of that Lecture, requiſite to the illuſtration of the views principally offered to the conſideration of the Public in this Treatiſe. I would have added to theſe a Theſis, publiſhed a great many years ago, expreſsly on the ſubject of *Light*; but, as I hope, my views will be ſufficiently comprehended without it, I am unwilling to encreaſe this ſmall volume unneceſſarily.

I AM not of conſequence enough to render this addreſs a compliment to the dignified Societies I have taken upon me to offer it to; though I intend it as a mark of my great reſpect for them. Ye are too wiſe, and too judicious, to be flattered into a partiality for falſe or groundleſs opinions: but to you particularly belongs the enlarging and ſyſtematizing of Science; I beg, therefore, you will only not account me preſumptuous for taking the liberty of preſenting, with the greateſt reſpect, the views contained in the following ſheets, as an appeal to your candour and diſcernment.

LONDON:
Adelphi,
May 8, 1776.

ERRATA.

Page 80. *line* 7. *for* complexion *read* completion.
Page 135. *line* 18. *for* natural *read* neutral.
Page 153. *line* 15. *for* contact *read* concuſſion.
Page 182. *line* 10. *for* as *read* whereas.
Page 183. *line* 5. *for* happens *read* happen.
Page 192. *line* 3, *note*, *for* relapſe *read* elapſe.
Page 194. *line* 20. *for* return *read* returns.
Page 202. *line* 8. *for* priſion *read* origin.
Page 155. *line* 8. *for* in *read* into.
Page 269. *line* 7. *for* them *read* both.

N. B. The Diſcourſe on Fevers, mentioned page 162, as a part of this work, is prevented from being inſerted by an unforeſeen accident.

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AN ENQUIRY, &c.

IT happens too frequently, that, from ſome general, imperfect, but by no means exquiſite, analogy among Symptoms, very different diſeaſes are either miſtaken for one another, or are confounded indiſcriminately together. There is not, I believe, one other ſuch general cauſe of miſtakes in the whole compaſs of the practice of medicine, as this. Nor can this cauſe of errors be redreſſed, until ſome medium is diſcovered and eſtabliſhed for reducing men's aſſumption of phyſical principles, and their method of reaſoning upon facts to a greater preciſion and uniformity.

THERE certainly is, in every Science, ſome leading Truths, which, like the trunk and greater branches of a tree, or like the great veſſels of the animal œconomy, communicating with every twigg and filament of each, renders the parts of the whole traceable, either backward or forward, and demonſtrably unites them together. He would be a happy Genius, and merit much of the Public, who could diſcover and well demonſtrate theſe leading principles, and truths which pervade the whole, and unerringly guide the underſtanding, in a Science of ſuch importance as medicine is, when the knowledge of it comes to be reduced to practice and application.

IT is from an error of the abovementioned kind, from ſome ſimilarity of ſymptoms, common to Hyſteric and Hypochondriac diſeaſes, that theſe two have generally been accounted analogous diſeaſes, diſtinguiſhed in their names only, to diſtinguiſh the ſex that is the ſubject of the diſeaſe. But this I take to be a total miſtake; which I propoſe to correct at preſent, principally by endeavouring to aſcertain the nature of the Hyſteric diſeaſe, and by ſhewing that it is a diſorder peculiar to the female conſtitution, originating in it from cauſes that have no exiſtence in the habits of males. With the ſame propriety, may ſome ſpecies of Epilepſies, and ſome ſymptoms occaſionally produced by Worms, be ranked with Hypochondriac and Hyſteric diſeaſes, as theſe two diſorders can be confounded with one another.

In order therefore to form as clear and adequate conceptions as poſſible of the Hyſterical diſorder as diſtinguiſhed from all others, I apprehend it is requiſite firſt to aſcertain what is common to the conſtitution of both ſexes, as diſtinguiſhed from what is peculiar to the nature and conſtitution of females.

CHAP. I.

The Identity of the General Nature of the Sexes.

THERE is nothing, ſo far as reſpects diſeaſes or morbid affections, peculiar to males, or to which females are not expoſed in common with them. As individuals of one ſpecies, they have a common conſtitution reared and ſupported upon the ſame general animal principles and laws, and ſubject to the ſame infirmities and affections which are acceſſory to the generating of diſeaſes. It is true that the different degrees of that common conſtitution diſpenſed to each ſex, and indeed to each individual, renders one more expoſed than another to this or the other diſeaſe, yet from the danger of which neither is totally exempted.

It is alſo true, that each Sex has its own characteriſtic organs and parts which the other has not, and that theſe may be the ſeat of diſeaſes; but of ſuch only as both are incident to. All the parts of each Sex, however diſtinguiſhed in form or office, are compoſed of the ſame animal materials, ſolids and fluids, blood-veſſels and nerves, membranes, and glands, &c. which are incident to the ſame caſualties and diſeaſes, whether general or particular, topical or univerſal. In ſo much then are females of the ſame conſtitution with men, that I do not recollect that diſeaſe males are liable to, that women are abſolutely exempted from.

Nay more; that ſyſtem of reciprocal deſire and attraction, that principle of coaleſcence, which, by the irreſiſtible deciſion of the excellent Former of our natures, bends the ſexes towards each other, and is ordained to unite them inſeparably in perſon, affection, and intereſt; That, I ſay, can afford no foundation for the characteriſtic diſtinction of the ſexes I enquire after. For a ſympathy which is as undiſtinguiſhable in its feeling by the different ſexes, as joy or grief is, and which has nothing in it, and tends to nothing, but what is mutual, cannot, by any diſorder of it, be productive of diſſimilar diſeaſes or effects in conſtitutions formed in every reſpect alike, both as to materials and animal compoſition.

CHAP. II.

The Sexual Degree of Bodily Conſtitution belonging to Females.

THOUGH the animal nature and conſtitution of females in every reſpect ſymbolizes with that of males, yet we ourſelves being judges, muſt admit that there is a great odds in favour of females, in reſpect of delicacy of frame.

NATURALISTS in all ages have allowed this. The old phyſicians expreſſed this very imperfectly, by the terms *colder* and *hotter*; nor have the moderns come more up to the point, by the diſtinction of *weaker* and *ſtronger*. If the diſtinction could be comprehended under two Epithets, I apprehend the terms *finer* and *coarſer* would come much nearer the point; as the ſame materials and pattern may be manufactured upon a coarſer or finer plan.

In females, the proportion of their fluids to the ſolids in their compoſition is greater; the fluids themſelves are leſs denſe and tenacious, and more ſuſceptible of rarefaction than in males. Their ſolids, both in their ultimate fibres, and in their contexture into larger veſſels, are of a finer extenſion; and both their ſolids and fluids are more yielding and ſuſceptible of the influence and energy of that ethereal fluid, which is the immediate principle of mechanical, natural, or animal life: Hence the organs of their ſenſes are endowed with more ſuſceptibleneſs; their muſcles and ligaments are more flexible and active, tho' ſooner exhauſted, and their ſkin is purer, more delicate and extenſile than that of men.

On theſe accounts, the ſenſes of females are quicker and more lively; and though they cannot vie with men in ſtrength and robuſtneſs of conſtitution either of body or mind, yet, by the flexibility of their frame, they are formed for bearing ſhocks and ſuſtaining alterations, and even pains in their conſtitutions, which that of males would ſink under the impreſſions of.

In ſhort, they are not colder or weaker, by any defect of the powers of nature rendering them leſs ſuſceptible of a perfect animation, but by a finer and more ſubtile intention of its energy. The flexibility and ſoftneſs of their frame is a deſigned work of art; and proceeds not from a defect of nature, leaving them uncapable of being ſo perfectly animated by the powers of life as males are.

As I have once and again made mention of the vital, as a material mechanical principle, I think it requiſite, in order to be more clearly underſtood in the ſucceeding parts of theſe diſcourſes, that I ſhould here explain myſelf upon that ſubject; premiſing this, that I would by no means be underſtood to include, Conſciouſneſs, and thoſe higher powers of the rational ſoul, which elevate our capacities for the reception of intellectual life and immortality, in my ideas of the principle of animal life.

C H A P. III.

The Sidereal Part of the Conſtitution of all Terrene Bodies, and of the human Frame in particular.

IF I cannot deliver my ſentiments on this ſubject with ſufficient conviction, I will at leaſt endeavour to do it as explicitly, and with as much preciſion, as I can.

So many occult qualities, inſcrutable principles, and indeterminate powers have been, and are, by Ancients and Moderns, introduced into a co-operation with the materials and mechaniſm of the animal frame, that it is become impoſſible to define or conceive, what we are ſuppoſed to be a compoſition of, or wherein animal life conſiſts.

THE whole, in my opinion, is the reſult of, and ought to be referred to, material mechaniſm; and my reaſon for this concluſion is,

IF all theſe, commonly ſuppoſed occult qualities of activity and unintelligible ſymptoms of power and energy reſident in, or annexed to, different material ſubſtances did not depend on mechaniſm and that only, then it would be impoſſible that ſuch virtues could be either generated or deſtroyed.

PHILOSOPHY does not ſuppoſe that mechaniſm can affect ſuch properties of bodies, as belong to them independant of it. Mechaniſm, or a new diſtribution and arrangement of materials, could not in that caſe generate elaſticity out of non-elaſtics or plaſtics, electrics out of non-electrics, or concoct life, and the various ſeemingly unrelated ſymptoms of vitality in the animal compoſition, out of materials that are endowed with none of theſe principles. But the fact is, that Nature * ſeems to have an unlimited power of inverting and changing, and generating all the ſpecific qualities of bodies according to the modulation of the material organs that it occupies.

MATERIALLY, the living animal frame conſiſts of two parts.——ORGANICALLY, it is diſtinguiſhable into three parts.

THAT ingenious old phyſician and philoſopher, Tachenius, reduced all the natural principles of things into acids and alkalis; the one the ſoul, the other the body of every natural ſubſtance.

CHANGE the terms, and the truth of his doctrine will become both more evident and more intelligible.

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* By *Nature*, I would always be underſtood to mean, theſe ſubtile principles of the mechaniſm of the world, and of all material things which are inſenſible as cauſes, and diſcover themſelves ſenſibly, only by their effects.

Every material being, through all the forms of nature that have been, are, or can be known, is a compoſition of CELESTIAL and of TERRESTRIAL matter. This diſtribution of matter into theſe two claſſes, which is the real key of all natural knowledge, not only diſtinguiſhes this globe from the celeſtial fluid in which it ſwims, but it is to be applied to every individual terreſtrial ſubſtance; which muſt be conſidered as an intimate compoſition of theſe two elements; the latter being the organ or caſe of the energy of the former, and the modifier of its inceſſant activity; while the former impreſſes theſe characters on the latter, which are known by the name of the diſtinguiſhing properties of different bodies.

For almoſt theſe forty years paſt, the curious have been teazing this celeſtial matter with the varied experiments and tricks of electricity, with ſo little ſucceſs, as not to have yet aſcertained, that it is the one omnipreſent animating principle of all natural things, upon which every property and phœnomenon of material being, under all the metamorphoſes and transfigurations that natural bodies undergo, depends; and without which, all that we call Body, would remain for ever an inactive, paſſive, incoherent calx.

THIS celeſtial matter is no other than the fluid of LIGHT; which, according to the variety of the phœnomena by which its energy has been diſcovered to us, has been called under different circumſtances, Light, Fire, Ether, Electrical Aura, Materia Subtilis, Materia Media, &c. and which at other times, has been ſtripped of its materiality all together, and treated as a principle annexed to, or inherent in matter, under the terms of, Occult Quality, Niſus, Attraction, Gravitation, Elective Attraction, Elaſticity, Irritability, Sympathy, Vital Principle, Life, &c. &c.

I SAID, that ORGANICALLY CONSIDERED, the animal living frame was diſtinguiſhable into three parts; namely, Solids, Fluids, and an Etherial Form which animates every particle of each of theſe in our compoſition.

THIS celeſtial part of our conſtitution exiſts in us, and indeed in every other form in nature, in two modes; namely——interſtitially and organically.

IF the pores of gold itſelf, the denſeſt of all known earthly ſubſtances, exceed its ſolid or earthly parts, how much greater muſt the proportion of ſolar fluid in our compoſition be, than in that of gold?——Let me illuſtrate my meaning by an example of the moſt ſimple of all known bodies, namely, the element of water; which when perfectly pure, conſiſts, ſo far as human analyſis or penetration can diſcover, of perfectly ſimilar parts.

IN the form of water, thoſe ſimilar parts which conſtitute the fluid muſt have interſtices between them, even admitting them to be all in contact with one another. Water, by its tranſparency certifies our ſenſe, that light has free acceſs into and through its ſubſtance, and therefore muſt fill up theſe interſtices, juſt as water does a ſponge ſoaked in it.

BUT we know, by the volatiliſation of water, that light or fire, has not only acceſs to its interſtices, but penetrates and occupies its ſimilar elementary particles alſo; in the conformation of which particles, the character of water conſiſts. Theſe particles could not be rendered volatile but by internal dilatation, nor could they be dilated but by ſomething that reached their internal parts.

THESE particles then are the organical parts of water, which have their individuality as ſeparable elementary

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parts; as well as their ſimilarity of character, preſerved by that etherial principle poſſeſſing them.

These points being cleared, they yield a clear and obvious ſolution of all theſe obſcurities with which preſent phyſiologiſts puzzle themſelves, and ſeem diſpoſed to reſolve into ſome incomprehenſible myſtery; ſuch as, What is the principle of life? Wherein does it conſiſt? Where,—in the ſolids or in the fluids,—does it reſide? Is it not plain, that both muſt be neceſſarily the immediate organs and receptacles of it; and that each muſt be equally acceſſory in every point of our frame, to the ſupport of its vivacity in the other*?

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* Modern phyſiology has bewildered the ideas and conceptions of pupils in the ſcience of medicine, by not diſtinguiſhing between the term *Life*, uſed *metaphyſically* for our ſyſtem of conſciouſneſs, or as a reſult of our whole compoſition, explicable only by the Creator; and

The vital ſtate of this ether in our fluids, lies not abſtractly in the degree of heat it exhibits in animals: For heat aſcertains the quantity only, but not the modification of the motion of that fluid in animals. It lies not in any permanent properties in the component parts of our fluids; but it lies in that ſpecies and modification of its motion, by which the actual conſtant progreſſive mutations of the fluids are carried on, of which the maintenance of the animal heat is a neceſſary conſequence.

Whenever the fluids have paſſed through that ſeries of mutations or digeſtions, which the vital ether accompliſhes according to the modifications

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and the ſame term uſed *phyſically*, to denote the natural power that preſides in our frame, reciprocally regulating, and regulated by the mechaniſm and diſpoſition of the whole, and of every part and particle of our corporeal frame.

of the diverſe parts in and according to which it acts, then they are either fixed as ſolids, where any parts will admit of them, or they are expelled as recrementitious ſubjects become effete, and whoſe vital modifications are exhauſted.

By the medium and inſtrumentality of the ſolids, indeed, the vital principle celebrates theſe functions, acts in theſe directions, and with that ſtability which could not be attained by fluids alone, though their inceſſant co-operation in their vaſcular ſtate is eſſentially neceſſary to theſe functions of vitality that immediately depend on theſe ſolids.

In ſhort, by the unremittent, reciprocal corruſcations of this vital principle in the fluids and ſolids upon one another, according to the different qualities and conſiſtencies they aſſume in the different parts of our conſtitution, is the whole ſyſtem of life diſplayed and maintained in every individual.

One ſtrange opinion I muſt take particular notice of, that has ſomehow or other been admitted of late, and paſſed current among many phyſiologiſts; that, namely, the ſolids are ultimately an accretion of earthy particles, ſucked together, ſomehow or other out of the blood, by, I ſuppoſe, their elective attraction, or ſome ſuch imaginary inherent power of aſſociation.

Nature in my opinion, employs no ſuch bodies formally in her operations, as what naturaliſts and chymiſts mean by terreſtrial particles. Caſually, there may at times be found ſuch inorganical particles as are called terreſtrial, floating in water or other fluids; but earthy particles in that form, Nature never uſes or blends in her compoſitions either fluid or ſolid.

WATER, ſalts, and oils, are the formal elements ſhe uſes in all her operations.

THE laſt of theſe is Nature's final concoction; and out of theſe oils properly concocted, condenſed and incorporated with a certain proportion of the other elements, are all the ultimate ſolids both of animals and vegetables compoſed. Perhaps, I might venture to include minerals alſo. I doubt if Nature exhibits any ſolid, without employing what Chymiſts have called Sulphur, as the principal baſis of them.

I KNOW nothing of any kind of fixed air eſſential to their compoſition; except ſome elaſtic acidity or acidulous effluvia that may be drove out of ſolids; which, while it entered the compoſition, and formed a conſtituent part of the ſolid, was cloathed with a ſulphureous form *.

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* This matter I have explained my opinion more fully upon, in a note towards the end of my diſcourſe, on the Cauſes of the Circulation of the Blood.

THE earth that remains ſo plentifully after the calcination of ſolids, is no more than the ruins of the neutro-ſaline and oily particles, which before the oil took form, was the neutralizing part of the ſalt, out of which it was concocted and inverted into an oil; that part in the oil which was the acid exploding into actual flame, or conſtituting the ignition of the coal, while as much of the neutralizing part of it as is not elevated in the form of volatile alkali, remains in the form of an inert inorganical earth. Inorganical, I call it, in a limited ſenſe; becauſe it is no form employed in the proceſſes of Nature; but no terreſtrial ſubſtance that the matter of fire or light has acceſs to, can remain abſolutely in an inorganical ſtate.

CHAP. IV.

Of the Refinement of the animal Principles of the Female Conſtitution.

HE muſt be very partial indeed, and blind to the deciſion of Nature, who is not conſcious of the ſame ſuperior elegance and delicacy in the temper and ſpirit of females, as there is in the ſtructure of their perſon and form. There have been at times, women who have ſhewed themſelves not incapable of all theſe acquiſitions of learning, and of that ſuperiority of underſtanding, which all men boaſt of in a few of their ſex. Nay, if there is much reſpectableneſs of capacity in that, there have been women too, who have played the crafty ambitious politician, or the heroic tyrant as much to the life as ever any man did. But there are pre-eminences in their natural diſpoſitions, more excellent than theſe that are diſplayed ſo conſpicuouſly in the popular walks of patriotiſm or faction, or even in the more envied and more myſtic labyrinths of ſtate.

THE female nature is moulded for a more important ſuperiority and a nobler department in the republic of human nature; for an abſolute juriſdiction over the regions of infancy and the dawnings of life; where human nature is proud of its dependance, and obedience is the moſt exquiſite happineſs. This is the golden age of life, when females ſway the deſpotic ſceptre of unlimited tenderneſs and affection; where the loftieſt monarchs never can enjoy that happineſs in commanding, that they have felt in obedience and dependance, and which the beſt of them would, if they could, renounce all the pageantry of greatneſs and royalty to retaſte the innocent careleſs joys of.

IN truth, the minds of females, as well as their perſons, are formed for the moſt important offices of humanity;—the charge of infancy, and the ſuſtaining with patience, that trouble in their own perſons, which is annexed to their bringing infants into life. Therefore all their feelings are ſofter and finer; all their paſſions are more delicate and more exquiſitely tempered with ſentiment; their imagination is more lively and fertile, and their apprehenſion is quicker. At the ſame time, their temper is more mild and acquieſcent; their moral ſentiments are more genuine and pure; being leſs corrupted and tarniſhed with the diſtinctions and ſophiſms of reaſoning, their deſires and purſuits are more limited and leſs exorbitant; their engagements, and therefore their enjoyments, being more domeſtic and beneficent, are conſequently more virtuous and moral in their nature.

It has been conſidered by ſome who would be thought philoſophers, as a proof of female weakneſs, that they are more ſuſceptible of religious impreſſions than men. But when we conſider that the evidence, the ſtability, and importance of religion, is baſed on the certainty of the evils it is propoſed to redreſs; and that nothing but the inviſible truths thereof, and its ſpiritual proſpects, could ever have been found an adequate and rational balm for the certainty of death, the uncertainty of life; the miſeries, the vanity, the folly, and the vices of human nature; when we conſider theſe things, I ſay, we muſt conclude the philoſophy of ſuch reaſoners weaker than the credulity of the ſex they affect to impeach; for what is in fact a valuable excellence, founded on the conſtitution of their mind, and the department aſſigned them, on the ſtage of temporary exiſtence. If in all religious aſſemblies, as I have heard it often obſerved as a reflection on the ſex, the women out-number the men, I would have ſuch candid cenſors to remember, that the deficiency of males on ſuch occaſions, is not to be attributed ed to the ſuperior cautiouſneſs of their underſtanding againſt ſeduction, but to the greater indifference of their minds to the ſubject.

In fine, as women are aſſigned on the theatre of life, a ſeries of labour, ſuffering, and tender duties, in the cheriſhing and rearing of infant-being, which the refractory, unſuſceptible compoſition of males diſqualifies them for; therefore, they are diſtinguiſhed with a refinement in the execution of their whole frame, both of Body and of Mind, which would render them the objects of our envy, if the whole was not wrought up into a captivating elegance, not to excite tranſitory delight, but to engage us into union with them for life, and animate us with every tender ſentiment and attention that can contribute to their happineſs, or alleviate the ſufferings and afflictions they are neceſſarily expoſed to, in fulfilling the ordinances of their ſex.

CHAP. V.

The Caſualities and Incidents to which the Female Conſtitution is expoſed.

THERE are many peculiarities in the conſtitution and circumſtances of females, that operate as cauſes, unknown to males, of almoſt all theſe diſeaſes that both ſexes are ſubject to in common; therefore it is no wonder if that ſex is accounted tender and more ſubject to diſeaſes than men; but this is not through the infirmity of their conſtitution, but by reaſon of the various viciſſitudes and revolutions in it.

BOTH ſexes are ſubject to a change of conſtitution, in paſſing from puerility, or a ſtate of nonage, (during which period, their conſtitutions may be accounted the ſame,) into puberty; or that age in which the plan of nature in diſtinguiſhing the Sexes, begins to unfold and explain itſelf.

The conſtitution of males rarely ſuffers any danger, and not unfrequently is improved or mended, particularly of ſome diſeaſes, by that change. The reaſon is, becauſe, at that period, Nature has no new, involuntary ſources of ſecretion, or ſtrainers of fluids to open in them.

In females, on the contrary, Nature at that time has an involuntary derivation from their fluids, which it was unaccuſtomed to before, to open and to eſtabliſh for the future. If there is any diſeaſe, topical weakneſs, or flaw in the conſtitution, when Nature comes to addreſs itſelf to the accompliſhing of this great change; theſe not only act as impediments to the deſign of nature, and are the cauſes of diſturbing the whole conſtitution, and of bringing on a bad habit, or encreaſing the diſorders of it; but if the different parts of the conſtitution are not all equally firm and qualified to reſiſt the encreaſed momentum of the blood at that time, the direction of Nature becomes inverted, and the lungs, for example, or any other weak part becomes the receptacle of that fluid, which was intended to be ſeparated from the blood, by a natural channel.

THOUGH the periodical derivation peculiar to the female ſex, is neither accompliſhed nor determined in its periods, by a mere plethora, or overfulneſs of the blood-veſſels; yet whenever that diſcharge is ſuppreſſed, it is ſure to induce a plethora. In other words, the conſtitution in its natural ſtate of health, opens theſe periodical fountains of public life, as they may not improperly be termed, not becauſe it is over-full of blood, but by a ſecret vital irritation on theſe organs, diſpoſing them to remit their ordinary retentive power, in order to keep them in exerciſe, and prepared always for miniſtering elementary living ſubſtance to new principles of being. In any diſappointment therefore that Nature meets with in the performing of this derivation, it is the reſiſtance to the tendency or niſus of the fluids, and not an univerſal overfulneſs of them through the whole conſtitution, that is the cauſe of the plethora, and diſorder felt in the habit.

There are ſundry cauſes that render this periodical ſubſtraction from the female blood very critical and apt to be diſturbed, to the great hurt and danger of their conſtitution.

All other natural derivations are open from the beginning of life; Nature, from the moment of birth, is habituated to them; therefore its courſes are well eſtabliſhed. Not only ſo, but in all other ſecretions, Nature is uninterruptedly, and without ceſſation employed: Perſpiration, the ſecretions of all the glands, *&c.* go on without intermiſſion. But this characteriſtic derivation of the female ſex, is periodical and ſtationary, and ſuſpended by ceſſations, far more prolonged than the duration of its flux is.

AGAIN, this flux has its period of final termination as well as of firſt commencement; the one as much ſubject to accidents affecting the health and conſtitution as the other. Add to all this, that the fluid thrown off in this operation peculiar to the female nature, is not an altered fluid, a changed liquor concocted and drained off by any glands. It is pure, perhaps the pureſt, moſt vital and animated blood; which Nature in no other caſe has regularly deſtined for ſecretion or being parted with, otherwiſe than by tranſmutation into other more permeable fluids.

All theſe circumſtances are like ſo many critical points, upon which the health and well-being of the feminine nature momentarily depends.

How various again are the accidents to which the health and conſtitutions of females are expoſed during pregnancy, and of how many different kinds, according to the different ſtages of it! It exceeds the intention of this undertaking, to claſs or enumerate them.

But ſuppoſing, what happens for a wonder only in a few very happy conſtitutions, that a woman eſcapes all theſe, yet certain trouble and anguiſh, beſides many uncertain difficulties and dangers, attend her period of delivery. Though both mother and infant eſcape alive, yet Nature has ordained that the breaking up of ſuch an intimate union, the rending of life from life, ſhall not be effected without exquiſite ſuffering and pain; while danger hovers over every hour of the mother's recovery from theſe ſhocks, till Nature has repaired them, and re-eſtabliſhed the conſtitution again, in the habits of the Sex. In ſhort, the only duty peculiar to the ſex, in which Duty, and Pleaſure, and Benefit to the Conſtitution, are almoſt perpetually united, is Nurſing. There is no pleaſure ſo pure or more exquiſite, nor any duty ſo ſalutary and wholeſome as that is in general; though not univerſally.

CHAP. VI.

The Characteriſtic of the Female Nature and Conſtitution.

HIGHLY uſeful as anatomy is, in acquainting us with the Organs, their Structure, their relative parts, Relations and Connections, Intercommunications, &c. in and by which the different functions of our ſyſtem are diſcharged; yet it goes but a very ſhort way in unfolding to us the diverſified ſpecific powers of each Organ. What that ſpecific power and ſtructure in them is, which enables one gland to concoct and ſecrete one kind of humour, and another gland, another kind, lies out of the reach of the knife, of injections, or the optical glaſs to detect. Therefore the ultimate object of all theſe labours in phyſiology, tends only to aſſure the underſtanding of this concluſion, that mechaniſm is abſolutely neceſſary to Nature, in all her moſt refined and ultimate operations.

But as Nature does nothing without mechaniſm, ſhe has alſo a wonderful power (indeed the moſt wonderful part of all her proceſſes) of generating her own future organs, in bringing forth new individuals.

In this only is the power of Nature limited: She cannot act determinately in generating new beings, excepting in a ſyſtem ſimilar to the beings ſhe generates. In ſuch, ſhe has an inexhauſtible power of generation; but without organs firſt compiled for her to act in, ſhe never could have produced one determinate being. The firſt production of mechaniſm throughout the whole compaſs of Nature is, therefore, as much a work of the Creator, as the birth of matter itſelf.

After all that is known of animalculæ, and ova, and of embryo's found in the Fallopian tubes, *&c.* the act of generation, and what individually each ſex contributes to it, remains ſtill a myſtery. Whether one ſex furniſhes the rudimental organ of an individual, and the other excites the firſt determinate action of that etherial principle that is to animate and poſſeſs it, I will not determine. However, I muſt ſay, that I think the learned and ſagacious Dr. Harvey's theory on that ſubject, has ſtill more veriſimilitude in it, than the doctrine of the animalculæ, and their nidi or ova; which to me carries this abſurdity in it, that ultimately it makes generation the work of the male alone; and which is ſtill more abſurd, it reduces the generation of living animals to the mere ſecretion of a gland or glands. Why ſhould Paracelſus's receipt in his Archidoxis, for hatching homunculi, be reckoned incredible by people who can believe this?

WHAT generation is, I ſay, I know not; but there are two things relating to it, that I have no doubt of. The firſt is, that the wills of the ſexes have as immediate a concern in it, and operate as immediately by their concurrence, as either their organs or their fluids do. The other is, that it is a ſimple act, which is perhaps as momentary as a ſtroke of electricity itſelf.

BUT however theſe things are, my ſubject has no further concern with them; becauſe I cannot reſt the criterion of the female character on a tranſient act, in which it is impoſſible to diſtinguiſh between two efficients, where the effect is one and common, however diſtinguiſhable the mode of their concurrence may be conſidered.

UPON this impreſſion of themſelves ſtruck by the ſexes, it is, that the characteriſtic powers of the female ſex begin to operate and diſplay themſelves.

GENERATION is an act of the ſexes; but CONCEPTION is the proper, ſole work of the female nature; and as conſervation ought, with the ſtricteſt propriety, to be conſidered as a continued act of creation, ſo is pregnancy in reality, a continued act of conception. It is for the ſake of this important work, that the Author of our being has adorned the ſex with all that comparative delicacy and elegance of body and mind, which I have already hinted at.

INFIDELITY and credulity are often as intimate aſſociates in philoſophical as in religious reſearches. Many phyſiologiſts, who make no doubt of the doctrine of *Animalculæ*, already hinted at, are abſolute infidels as to the poſſibility of infants receiving marks in the womb, from the imagination of the mother; but ſuch examples are too frequent and too well atteſted, to receive diſcredit from an occaſional philoſophic ſcepticiſm, and to be reduced to the article of mere contingency. I myſelf have ſeen inſtances of children born not only with marks, but with open running ſores, ſimilar, both in their ſeat, extent, and appearance, to accidental injuries the mother received during her pregnancy *.

There is as certain a correſpondence between the mind or imagination of the mother, and the form of the infant in the womb, as there is between an object, and its image in a mirror. The medium of this communication with

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* A pregnant gentlewoman ſtanding on the leaf of a folding-table to reach at ſomething, the leaf gave way under her, and in her fall, the edge of the table ſtripped her leg and thigh of the ſcarf-ſkin, from the ancle, to the middle of her thigh. The child was born with an open oozing tetter of the ſame extent on its leg and thigh, which ſometimes had been ſkinned over, though it always broke out in a ſhort time after. I was conſulted about that ſore, when the boy was about eight or nine years old, and in other reſpects a very healthy child. Various other inſtances of marks ſo impreſſed I could adduce from my own knowledge.

the infant, muſt be the ſame with the medium of its nouriſhment.

This reflection of the female mind, or of the form of life there, upon the ſeat of coaleſcence between the mother and the child, is, in my opinion, that very thing in which the female character conſiſts; and is the primary cauſe of that coaleſcence itſelf between the mother and the embryo. The one is thereby formed and qualified for irradiating, what the other is formed for drawing and taking in. It is this which opens the ſources of the mother's vital fluids, to the demands of infant nature: Juſt as the breaſts, which were empty immediately before, are well known to fill and flow, when the mother's tenderneſs begins to glow on the immediate proſpect of laying the infant to her boſom, that ſhe has been for ſome time abſent from.

THERE are ſome doctrines, and this is one of them, that demand illuſtration, rather than confirmation: In other words, illuſtration is the moſt ſatisfactory confirmation that can be given of them. This I ſhall attempt.

THERE is the ſame reaſon for ſaying that a child in the womb lives communicatively, as that it is nouriſhed communicatively. Tho' preſent phyſiologiſts have not determined what life is; they all agree that it is a principle diſtinct from the known materials, and ſenſible mechaniſm, of our compoſition; but while we live, I ſuppoſe they will admit, it is every where a concomitant of our ſubſtance.

As the exiſtence of this principle is known to ourſelves, and to one another, by the conſcious operations of our minds; we have as good reaſon to call the ſeat of theſe operations, the fountain of life ſhedding itſelf through every particle of our frame, as we have to call the heart, the fountain of our fluids.

Though we think conſciouſly, it does not follow, that we are conſcious of all that is performed in this fountain of life, or that conſciouſneſs attends all its inceſſant functions. When we will the motion of our eye, or of our toe, we are inconſcious of either the reality, or of the manner of the will's addreſſing itſelf to theſe parts. At the ſame time, we are as certain, as neceſſary conſequences can make us, that the will could never reach theſe members, unleſs in the ſeat of its action, it found ſome thing that correſponded with them.

Can we have any ſtronger rational demonſtration, that there is an active, living, material image of the whole frame, in the fountain of life, with which the conſcious mind correſponds at pleaſure? But though we feel this principle ſubſervient to our Conſciouſneſs in actuating our frame, it does not follow, that this is all the office it has to perform. On the contrary, we muſt conclude, that the ſame principle muſt inſenſibly to ourſelves perform all its vital functions by the ſame kind of energy.

WE have many other circumſtances to ſatisfy us, that it lives in neceſſary and uninterrupted influencing correſpondence with every part; inſomuch, that it would appear, if any part of that image was to be obliterated in the fountain of life, or its communication with any part interrupted or broken off, that part would ceaſe to live inſtantaneouſly, though the acceſs of our fluids to it was ever ſo free.

THAT this living modulation of our whole frame, ſupported by the re-action of every living part, or by the reaction of life in every part, upon the fountain of life in our compoſition, has neceſſarily the ſame inſtantaneous and permanent reaction on every part, is, in my opinion, a neceſſary conſequence: And that it is ſo in fact, we have demonſtration from the momentary effects diſplayed through the whole ſyſtem of our conſtitution, whenever this model of ourſelves in the fountain of vitality, is agitated in any ſpecific manner by our conſcious paſſions of Love, Anger, Fear, Shame, Joy, *etc.*

WHEN this is evidently the caſe, can it be any wonder, or in any meaſure unſuppoſable, that a particular part of the human conſtitution may be ſo formed as to be ſuſceptible of an impreſſion or regeneration of this intire image delineated and preſerved in it for tranſmiſſion to new beings, when they come to be preſented and annexed to it? This I have no manner of doubt is matter of fact, in regard to the organ and ſeat of conception in the female ſex.

THIS image of the whole frame of every animal in the centre and fountain of life, which ſheds its irradiations into every part it is the repreſentative of, I cannot by ſimilitude give a clearer and more diſtinct idea of, than by comparing it to the action of light in a focus, which contains as it were in a point, all that is delineated beyond it in an extended landſcape.

THOUGH I look upon this as a very near ſimilitude to the idea I would convey of what muſt be a matter of fact, however it is explained, yet when on this ſubject I uſe the term Image, or any other ſimilar to it, I would not be underſtood optically or literally. I mean a potential image, if I may uſe the phraſe; where there is, without the leaſt confuſion of parts, as diſtinct a concentration of the powers of life, as there is of forms in the focus of a perſpective glaſs.

THOUGH an infant in the womb has all the members and organs, and the ſame connections eſtabliſhed among them, which one that is born has, yet certain it is, that none of them act officially, until they receive a proper uterine complexion. They have nothing perſonal in their ſenſes, motions or ſecretions; theſe all follow the habit of the mother, and are affected by her feelings and ſenſations both of body and mind. They are ſhocked, influenced, and affected through her. Their life, as well as their fluids and ſolids, are her's: the whole is common to both: the life of the infant in that ſtate is totally derivative.

THAT wonderful elaboratory of human nature, the organ of conception in the female ſex, muſt have a capacity in itſelf, by ſome diſplay of Wiſdom in its ſtructure or contexture, of regenerating in itſelf that whole form, and all thoſe powers of life rendezvouſed there, in ſuch a manner as to be tranſmitted and diſtributed entire, and without confuſion to every correſpondent part and member of the vegetative infant, according to the ſimilarities of the different craſis and conſtruction of each.

Upon a collation therefore of all that I have ſaid relative to this ſubject, I cannot think that I expreſs myſelf with great impropriety, or ſpeak quite metaphorically, when I ſay, that by ſome ſpecial and direct connection between the fountain of life and the organ of conception in females, the ſeat of that procreative faculty in them is ſuſceptible of having excited or regenerated in itſelf, the image or powers of that whole faculty in the origin of life that correſponds with, and extends its influence and energy to, every part of the body; and that whenever a proper ſubject is generated there, there is during pregnancy an inceſſant tranſmiſſion of that vital image from the ſeat of coaleſcence to every conſtituent part of the infant: in ſome ſuch manner, to explain myſelf again by ſimilitude, as the image from the bottom of the eye paſſes through the optic nerve, to the ſeat of perception, or from that back again to the organ of viſion *.

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* We inattentively imagine the ſeat of ſenſe is paſſive in receiving images, but in fact, it alſo poſitively directs a ray from itſelf, to every object it perceives. The action and reaction between objects, and the ſeat of ſenſe, is wholly reciprocal. Hence, in ſome caſes, we are even conſcious of this; ſeeing objects, or their image, after the eye is turned from them; hence alſo, in a delirium, the objects of the imagination, receive a real repreſentation in the organs of ſenſe. For the ſame reaſon, we ſee not an object the eye happens to be fixed on, if the attention is otherwiſe engaged.

CHAP. VII.

This Characteriſtic of the Female Conſtitution the immediate Source of the Hyſterical Diſorder.

IT is this faculty, reſident in the Organ of conception, of having renewed in it an impreſſion of the whole ſyſtem of animal life, as it exiſts in its fountain, and irradiates its influence into every part; it is this faculty, I ſay, that is the immediate ſource of the Hyſteric diſeaſe, the nature of which, cannot be comprehended or explained upon any other principles. I obſerved before, that the mere diverſity of the form or compages of any parts that diſtinguiſh the ſexes cannot, for the reaſon I there aſſigned, be the foundation of a diſtinguiſhing diſeaſe. A characteriſtic diſeaſe muſt originate from ſome criterion of diſtinction between the ſexes.

This is not to be found either in the fabric, or any property belonging to the fabric of males, as has been before obſerved.

BUT the hyſteric diſeaſe diſtinguiſhes itſelf from all other diſeaſes in this, that it is a diſeaſe of *the principle of life itſelf:* That is, the leading principal ſymptoms of it are ſuch as act immediately upon that principle. That this diſorder has always been underſtood to derive its cauſe from the female Organs of conception, is evident from the name it bears: And that it was ſo ſingular in its ſymptoms, as to lead phyſicians to attribute it to the principle of life, is evident from the manner in which many of the old phyſicians ſolved the phœnomena of it, namely, by attributing to that ſeat of tranſmiſſion of life in females, a life of its own independant of the reſt of their conſtitution.

THE fact is, that inſtrument of the being and preſervation of mankind, is of ſuch importance, that the wiſe and provident Author of all things, provided, that when that member was diſturbed or interrupted, by the various accidents females are expoſed to, in its ſecretions, that theſe ſuppreſſions ſhould not generally, nay, I may almoſt ſay, univerſally, act in the manner of what we call topical obſtruction, producing any inflammation, ſwelling, or unnatural collection, or digeſtion of humours in the parts.

ON the contrary, he ſecured that organ from ſuch accidents, by endowing it with ſuch a degree of reaction to any load tending to ſettle there, as enabled it to react upon the whole ſyſtem of life, in order to vindicate itſelf from ſuch conſequences of obſtruction, as might injure the vital powers ſeated there, for the preſervation of the human race.

As, therefore, this Organ of ſuch importance, ſubſiſts in ſuch communication with the fountain of life, admitting and tranſmitting its whole entire impreſſions, is it to be wondered at, that upon any diſorder, it is thrown into by obſtruction of its office, it ſhould act by reflection immediately and directly upon the principle of life in the female conſtitution? For ſuch as diſtract it, are the leading pathognomonic ſymptoms of the Hyſteric diſeaſe.

C H A P. VIII.

The Symptoms of Hyſterics ariſing from Sympathy.

THOUGH ſuch, as I have ſaid, are the critical ſymptoms of the Hyſteric diſorder, yet they muſt not all be referred to that claſs. That repoſitory of communicative life, has, by its ſituation, connections with other parts, and connections by blood-veſſels and nerves, by which means, under its diſorders and diſturbances, theſe conſentaneous parts are affected.

THEREFORE hyſterical affections are to be diſtributed into two claſſes: Firſt, ſuch as are produced by conſent or ſympathy of parts; and ſecondly, ſuch as are an immediate reaction upon the principle of life itſelf at its fountain; from whence that Organ is always impreſſed and irradiated upon in the manner and for the purpoſes above explained.

THE provident Author of our being and determiner of the manner of our introduction into the world, has ſollicitouſly ſecured that elaboratory of mankind in the female conſtitution, from the common topical accidents that happen from obſtructions or diſorders of the ſecretions of other viſcera. I do not ſay, that ſuch never happen there: But only, that this important veſſel, by the powers belonging to its fabric and animation, is enabled in thouſands of inſtances to clear itſelf of the conſequences of obſtructions and irregularities, in the excretions peculiar to it, and to reflect them off itſelf upon other parts; when other viſcera in ſuch caſes would become ſo irremediably affected and diſeaſed, as to be the certain cauſes of death.

THE bowels, that is what are called the Abdominal Viſcera, and the urinary veſſels and organs, being moſt nearly and intimately connected, either by ſituation or correſpondence of both nutrient and ſentient veſſels, with this ſeat of conception; theſe ſuffer moſt by ſympathy in all Hyſteric diſorders. Hence ariſe Flatulencies, Indigeſtion, Nauſeas, Apathies, vitiated Appetite, convulſive Spaſms in the bowels, communicating themſelves to the gullet, and producing what is called the Hyſteric globe, or a ſenſe of ſome lump or obſtruction in the throat, and Hyſteric cholics, ſucceeded with ſlight temporary icteric or jaundiced ſymptoms; and from theſe diſorders in the firſt paſſages are frequently produced by ſympathy, alſo pains in the head, giddineſs, dimneſs of ſight, *&c.*

NOR are the ſecretions leſs affected in this diſeaſe; it being common in it, for the habit to be unnaturally either coſtive or the reverſe; but moſt commonly, the former extreme prevails. During the paroxyſms, or fits of the Hyſteric diſorder, there is always alſo either a ſpaſmodic ſuppreſſion, or a large flow of pale colourleſs urine; the urine at that time, though uncommonly plentiful, being almoſt deſtitute of theſe ſalts and oils, that are naturally intended to be floated off by it.

CHAP. IX.

The characteriſtic Symptoms of the Hyſterical Diſorder which demonſtrate it to be a Diſeaſe of the Principle of the Life itſelf.

BUT the moſt ſingular and remarkable part of this diſeaſe of Hyſterics is its diſcharging itſelf principally and moſt immediately upon the ſeat of the fountain of life; from whence, as I have ſhown, the organ of conception receives its ſpecific character and generating powers.

LIGHT is not more inſtantaneouſly diſpatched by reflection from a mirror, or by the power which every point of the air has of reflecting lightning *, than that with which the ſame fluid under the character and modifications of the vital principle, acts, from place to place, in the human frame *.

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* There is not a point in the air but what is capable of being excited, by the intenſe energy of lightning, to reflect it, in all its inſtantaneous deflections, almoſt as vividly as where the exploſion actually happens. Hence it is ſeen by thoſe within doors, from north or ſouth, eaſt or weſt looking windows at the ſame moment. I have ſeen the whole zig-zag meanders of a fierce flaſh of lightning deſcribed on the ſurface of a diſh of meat at table.

In the Hyſterical paſſion, the accumulated modification of this principle in the theatre of conception is ſo irritable, that it reacts inſtantaneouſly upon that original potential form of life, which ſtamps it with its procreating virtue.

It is on this account that this diſeaſe ſo directly and violently attacks all the

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table. I have even ſeen it as if among my fingers, when my attention was fixed on any thing between my hands.

* The moment of willing and of moving any member of the body is undiſtinguiſhably the ſame; ſo likewiſe the moment of being touched, and of the touch being felt. But theſe inſtantaneous tranſmiſſions in our frame, are not confined to ſuch as we have a conſcious perception of: They are inceſſantly tranſacting: the remoteſt vibrating artery correſponding with the heart, does not more immediately and conſtantly feel its power, than the material principle of vitality through its whole form, in our ſtructure feels the permanent influence of its own concentrated epitome, in the centre of its irradiations.

powers, both conſcious and inconſcious, of the centre and fountain of life. It extemporaneouſly aſſumes the appearance of all the paſſions, and of the ſenſible expreſſions of them; and inverts them into one another in a moment. Fear and courage, trembling and erection of the ſpirits, grief and mirth, laughter and weeping, anger and placability are metamorphoſed into one another in the twinkling of an eye. The imagination at one inſtant is perverted into a delirium; and the next, the underſtanding is ſuſpended or bewildered; the ſenſes ceaſe to act, and become intolerably acute by turns. The inſtruments of the will become convulſed, and violently agitated one while; and in quick ſucceſſion, all the ſymptoms of life are ſuſpended, and the whole faculties both of ſoul and body will ſeem as if they were extinct for many hours, nay, for many days together; inſomuch that ſome have been ſo unfortunate as to have been buried during the continuance of an hyſteric paroxyſm of that kind.

In ſhort, the whole form in the fountain of life, by which every part of the corporeal frame is ſupported and influenced, can be ſo affected by this diſeaſe, that every function of life, both animal and vital, ſhall be ſo eclipſed as to ſeem to have totally and irrecoverably ceaſed, and will then reſume all its powers again as placidly as if the perſon was only awaked out of ſleep.

These things could not be without form reacting upon form, and a reniſus or repreſſion of theſe formal powers of life collected in the medium for tranſmiſſion to new beings, upon the original from which they are copied, and with which they ſtand in conſtant communication.

All this cannot be performed by the ſole energy of a few correſponding nervous filaments; and yet it could not be done without them. They are the directors, but are totally inſufficient for being the conduits or ſole conductors of the variouſly-intended energy of the powers of life.

The plenum of life occupying and organiſing every particle and interſtice in our compoſition, diſcharges its whole niſus, according to the pathic intimations and direction of any nerve or nerves, as inſtantly, as electricity does through the whole ſubſtance of any body that receives its ſhock. In ſhort, whenever that power which has afforded ſo much entertainment to the world, in the form of electrical fire, and which is found to exiſt not only in the Torpedo and Gymnotus Electricus, but even in the Blubber*, and, perhaps in many other animals, in that form; whenever, I ſay, it comes to be duly attended to, in the form of vitality, it will be found to exhibit many phœnomena, more worthy of our admiration and inveſtigation *.

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* A fiſh common on many coaſts, of a circular form, and of the colour and conſiſtence of jellied ſtarch, to appearance, which cauſes a prickling in any part of the ſkin that it touches.—This I am told;—but there is a poſſibility, that the ſenſation may be produced by ſome ſingular vellicating quality in the ſalts of the animal.

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* Every individual is as completely a plenum of light or fire, under the modification of life, circumſcribed by its own exterior ſurface, as determinately, as if it was encloſed in an adamantine ſhell. And yet the univerſal energy of that ſame fluid, and of the atmoſphere combined with it, is abſolutely neceſſary to its ſupport every moment; but the living modification thereof, terminates preciſely with our ſurface.—Note, By *Light*, I mean the ſubſtance of that fluid, not that form of action which renders objects viſible to us.—By fire, I mean the ſame fluid. I know ſome have been ſo philoſophically abſurd, as to intimate the poſſibility that fire was nothing elſe than an intenſe vibratory motion of the terreſtrial ſubſtance of a body heated or ignited; but the extravagance of this opinion is too glaring to need much confutation. In the focus of a burning glaſs, light is concentrated into the moſt intenſe action of fire, and we know that fluid penetrates all terreſtrial things. —The inference is obvious and deciſive.—Note, By a plenum, I mean no more, than that the parts of that fluid exiſting in the ſubſtance of other terreſtrial bodies, which it permeates, and at the ſame time occupies organically, is in the ſame ſtate of fluid continuity as we conceive water is in a ſponge ſoaked full of it.

CHAP. X.

Farther Hints in regard to the Nature and Cauſes of Hyſterics.

IN the two preceding chapters, I have pointed out theſe ſymptoms, both ſympathetic and primary, which, I think, prove the hyſterical paſſion to be immediately a diſeaſe of the principle of life itſelf. That is, a diſeaſe not excited in any parts, by any fixed vicious ſtate either of the fluids or the ſolids: A diſeaſe occaſioned by no acrimony, fluxion, or obſtruction, ſettled on the parts where the ſymptoms of the diſeaſe are diſplayed.

So far is it from ſeeming to originate from any morbid ſtate of the particular part that gives riſe to it, that it ſeems rather to proceed from the exertion of powers reſident in that part, enabling it to rouſe or attack the whole vital powers of the ſyſtem, in order to preſerve and defend itſelf from any conſequences ariſing from accidental ſuppreſſions of its ſecretions, that may threaten to obſtruct topically, or injure that important veſſel in its public office and character.

But though this is primarily the caſe, it does not follow, that a long continuance of this diſeaſe, during the violent attacks of which the ordinary functions of both ſolids and fluids are diſtracted, ſuſpended or reverſed, may not injure at laſt, both the uterus itſelf, and other parts of the body, that it is often drawn into ſympathetic conſent with: but this muſt be conſidered as a conſequential effect, and not as a procuring cauſe of the Hyſteric paſſion.

Again, in regarding this diſeaſe practically, there are many other diſtinctions to be attended to: for we ſhall find it either accidental in a conſtitution perfectly whole and ſound, that has been ſuddenly expoſed to ſome injury of body or mind, at ſome critical period or revolution of the conſtitution. In theſe caſes, the perſons moſt ſuſceptible of the attacks of this diſeaſe, are generally ſuch as have the appearance of the greateſt health and of the fulleſt habits. After any occaſion has given riſe to it in ſuch conſtitutions, it frequently becomes recurrent and habitual, and conſequently becomes more difficult to be tamed, and ſubdued.

But the diſeaſe is ſtill more difficult to be treated, where it may be conſidered as conſtitutional. In ſuch habits it is generally leaſt violent, though moſt frequent in its paroxyſms; and is capable of being excited by any thing that agitates the temper or ſpirits. In ſuch caſes, it is often, though not always, found to have little effect in diſturbing the cuſtoms of the ſex: In ſome caſes it even tends to excite them, and awaken

ken them out of the courſe of their ordinary periods. Theſe perſons in whoſe conſtitutions it is in ſome degree inherent, are commonly of a habit not very full or groſs; but of quick ſenſations, and of a ſprightly, active ſpirit and mind: or elſe there lurks ſome latent fretting acrimony in their fluids, in which caſe, the diſeaſe muſt be conſidered complexly, as a mixture of the Hypochondriac and Hyſteric diſorders, fermenting in the ſame habit.

The period of life over which this diſeaſe extends itſelf is, from the firſt bias or direction that the vital powers take, towards impreſſing and eſtabliſhing the characters of public or communicative life, in the female conſtitution, till age gradually wears out the impreſſion. By this date, I do not mean the firſt ceſſation of the periodical refluxes of their fluids: for that is a period in which a particular type of the Hyſteric diſorder rages, as much as in any;

namely, that ſpecies of it, by which unhappy females, for a long courſe of time, even for years together ſometimes, are rendered miſerable both in their bodies and in their minds, by an unremitting, but conſtantly-changing ſucceſſion of pains, and very intolerable ſenſations of various kinds, in different parts of their body, but eſpecially in their belly (that is, among the viſcera and contents of the abdomen,) and in their head.

In ſhort, under this form and modification of this female diſorder, there is no diſeaſe, they do not feel the pains of, at times, or imagine themſelves affected with. At the ſame time, their mind is either over-clouded with deſpondency, and ſunk in them with the melancholy idea of their own deplorable caſe; or their imagination is viciated with ideas of evils and dangers hanging over them, and threatening them, which have no reality, but in their fancy; or they have an irreſiſtible tendency to talk for ever, of the various endleſs ſenſations of their diſeaſe; which they think no deſcription can comprehend, nor can it at all, they imagine, be put into language: in ſhort, they know no end of repeating, deſcribing, and talking over their complaints.

PERSONS who live low, are expoſed to much cold, who are wanting to themſelves, either through negligence, parſimony, or poverty, or who have any latent ſcorbutic acrimony in their blood, are moſt ſubject, upon the ſecond great turn of life in the female conſtitution, to this ſpecies of the Hyſterical diſeaſe.

CHAP. XI.

Of that Revolution in modern Conſtitutions, which renders them more incident to Hyſteric and Nervous Diſeaſes.

THE Hyſteric diſeaſe is one of thoſe which have been accounted much more frequent and univerſal of late ages, than it was formerly. One ſpecies of it certainly is ſo. But when it has been conſidered in this light, it has been indiſcriminately confounded with nervous diſorders in general, or what are called diſeaſes of the ſpirits, as they are common to men as well as women. Though theſe are to be diſtinguiſhed from what is ſtrictly and properly hyſterical; yet it muſt be allowed, that to whatever cauſe the greater frequency of nervous diſorders is to be referred, the ſame cauſe muſt operate in rendering hyſterical complaints more frequent alſo. So that what I ſay upon this ſubject, will be equally applicable to the ſource or remote cauſe of nervous diſorders, (commonly ſo called,) in general, and of the Hyſteric paſſion in particular.

WHATEVER is the cauſe of the general change induced upon the human conſtitution, within their ſphere of obſervation who admit of the fact; I think it muſt be allowed to be a change, upon the whole, for the better and not for the worſe. For this reaſon, I cannot help charging the Academy of Dijon, with being guilty of great weakneſs of judgment, (as ſuch ſocieties will ſometimes be,) when they conferred their premium upon that flimſey oration of Mr. Rouſeau, in which he extolls the conſtitutions and manners of the ancients ſo highly above theſe of the moderns.

I DARE preſume to affirm, that the ingenious declaimant never once reflected, that he owed all his ſophiſtical ingenuity, with which he ſupported his parodoxical arguments againſt the ſuperiority of the moderns, to his nervous, whimſical, modern conſtitution: nor ever once conſulted with himſelf, whether he would prefer a robuſt, athletic, hard-tempered conſtitution, with a blunt, impetuous, unſentimental ſpirit, to a more delicate, nervous, ſenſible frame, connected with a ſentimental ſpirit, capable of receiving a luxurious impreſſion from every beauty of nature, and of entertaining his own wild, fertile imagination, with the debauching of an Eloiſa, the rearing of an Emilius, or with the ordination of a Savoy Curate, with a character ſuitable to his own ideas.

Most certainly, generally ſpeaking, the powers and pleaſures of the imagination and mind, follow the habit of the body; nay, if I were to ſay, that the improved conſtitutions of bodiespolitic were connected with it too, I believe, I ſhould not err much from the mark. I do not know, whether the bodily conſtitutions of Alexander and Cæſar, would have been proper caſes for the ſentimental philoſophiſing minds of Ariſtotle or Cicero; but I am pretty certain, that neither of the latter would ever have diſtinguiſhed themſelves greatly at the heads of armies. If we cannot ſo indefatigably as the ancients ſcamper over hill and dale, enjoying the butchering purſuit of the chace, or of routed legions; we are at leaſt as well qualified as they, for walking in fields or gardens, and for enjoying the natural delight infuſed by the proſpects of rocks and fountains, mountains and plains, foreſts, and fertile fields. With the conſtitutions that moderns have, ſoldiers, though perhaps they cannot draw the bow ſo bent, or dart the launce ſo far as the ancients, they are as athletic and ſanguinary, as there is occaſion for in the happier ages of declined barbarity, and improved humanity of mind.

As I am about to aſſign what I think the moſt probable reaſon for the revolution, which has happened in our conſtitutions within theſe two centuries, I hope the reader will forgive this ſhort digreſſion by way of an apology for them.

OUR country is the ſame that it was always, and ſo I believe is our climate; excepting what changes in it may reſult from the improvements it may have received by the extirpation of woods, or the cultivation of lands; but theſe are rather in our favour. Our food, and our manner of living, then muſt have been altered. They are ſo. Since the trade of the Eaſt and Weſt Indies opened upon us, a great alteration of both theſe has been introduced, eſpecially among thoſe who are above the labouring ranks of life.

The alterations of dreſs in favour of elegance and cleanlineſs, have greatly circumſcribed our exerciſe. A perſon who has contracted a taſte for cleanlineſs of dreſs, is naturally reſtrained from either the quantity of exerciſe, or the varieties of it, that he would otherwiſe engage in. This ſoon grows into a habit, which fixes that quantity of exerciſe that we find either agreeable or neceſſary. As exerciſe has a great effect in ſtrengthening the ſolids, encreaſing the heat and circulation of the fluids, and in ſhort, in winding up the ſprings of life; ſo comparatively, inactivity muſt be accompanied with a more relaxed and leſs indefatigable conſtitution.—Such conſtitutions as we acquire or form to ourſelves, ſuch do we tranſmit to our deſcendants.

Now, though this is certainly the caſe, it does not follow, that our conſtitutions with the quantity of exerciſe they are formed for, are leſs qualified for holding out to the lateſt term of life, than thoſe of our forefathers. I believe there are as many die of a good old age now, as there did then. But on the other hand, I am afraid it cannot be ſaid there are as few die in infancy now, as there did then. This leads me to ſay ſomething on that ſubject.

CHAP. XII.

The Subject continued. The Effects of the Abuſe of Sugar conſidered; particularly in regard to Infants.

IT is to America chiefly, and not to Aſia, that we owe the principal cauſe of the alteration of our conſtitutions, and the encreaſed mortality of infants, unknown in more barbarous times; the populouſneſs of which times conſiſted in the healthfulneſs of infancy then, and in the greater proportion of thoſe, who arrived at the years of maturity, and not in the greater number of thoſe who lived to a great old age.

A DELICATE infant cannot bear the ſame expoſure, hardſhips, neglects, and various miſmanagements, that would only contribute to harden and temper one of a more vigorous robuſt frame.

Therefore, the children of more delicate deſcendants cannot ſuſtain the ſame food and education as formerly; while at the ſame time one conſtant ingredient of their food, which old and young were equally ſtrangers to, in former ages, is ſufficient to enervate the ſtrongeſt ſtamina of infancy.

It is not to the univerſal uſe of tea, nor to the warm water in which it is infuſed, that the preſent race of mankind owe the greater imbecillity of their conſtitutions; but to the univerſal uſe, or rather abuſe, of ſugar in infancy, and the immoderate quantity of it uſed by the female ſex eſpecially, as the principal ingredient in their tea.

Sugar itſelf is ſo far from being unwholeſome or bad nutriment that, I believe, it is on account of its highly nutritive quality, that it is capable of becoming ſo noxious to our conſtitutions. Even in its coarſeſt, which is its moſt wholeſome form, its nutritive parts are too concentrated and ſeparated from its groſſer parts to be ſafely uſed, with that freedom as food which is more mingled with recrementitious parts, ſuch as the various farinaceous grains of which bread is made.

It is well known, that it is the nutritious parts of vegetables, (the ſaccharine, or what may be converted into ſaccharine parts,) principally, if not ſolely, that are capable of undergoing either the vinous or the acetous fermentation; and it is alſo known, that ſuch ſubſtances ſeparated from their groſſer parts, and properly diluted, when they are not put into ſuch circumſtances and ſuch a regimen as favours the vinous fermentation, are apt to paſs directly into the acetous fermentation, and to generate an acid; to which nothing contributes more than a greater degree of heat, than is required to promote the vinous change; which the heat of our bodies is.

Whenever, therefore, we mingle more of ſuch a ſubſtance as ſugar with our food, than our ſtomachs are able to digeſt, before it ferments and degenerates into an exceſs of acidity, (ſome is neceſſary in all well-regulated digeſtion,) then the ſuperfluity muſt weaken the blood, and encreaſe the ſaline parts too much, in proportion to its unctuous and other parts. Not only ſo, but when a ſuperabundant quantity of acid enters the blood, it neceſſarily weakens its craſis, by aſſuming other parts of the blood, tending to other changes in its healthy ſtate, in order to ſaturate or neutraliſe it, for no acid can remain any time in the blood, (ſuch is the nature of its digeſtions,) unſheathed or unneutraliſed, without great and immediate detriment to the conſtitution.

But though little acid can be detected in the blood by the more common proceſſes of chymiſtry, yet it always is there, in a neutraliſed and more refined ſtate; and an imperfect neutraliſation of any or all of that acidity, is the immediate cauſe of all theſe complaints which ariſe from what is not very improperly called coldneſs or weakneſs of the blood.

CONSTITUTIONS, then, formed on that exceſs or deficiency, call it which we pleaſe, in infancy; derived alſo from ſuch conſtitutions as are formed upon the ſame plan; and again, habituated through life to the exceſſive uſe of the ſame very aſceſſent ſubſtance, muſt differ very eſſentially in point of ſtrength, vigour, and heat, from conſtitutions uncooled, and not relaxed by any ſuperabundant fuel for acidity in their ſyſtem of food.

BUT though I have demonſtrated a cauſe adequate to the effect of reducing our conſtitutions in point of ſtrength, below the ſtandard of our anceſtors;

ceſtors; it does not follow, that our feelings, ſenſibility, *&c.* are inferior to theirs. On the contrary, it would ſeem that oils concocted (as they certainly are,) out of ſuch ſalts, are leſs groſs, finer, lighter, and more irritable than the groſſer, and more torrified oils in hotter conſtitutions. Beſides, the exceſs of ſalts verging more towards aſceſſency in our blood, muſt, by the irritation they produce, encreaſe the ſenſibility of the ſenſible parts of our ſyſtems; which, upon the whole, accounts for the encreaſed frequency of both nervous and hyſteric diſeaſes *.

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* To ſugar, that leading cauſe of the change of both our conſtitutions, and perhaps of the types of many diſeaſes, ought to be added, the great change of our cookery and high ſeaſoning, as alſo the greater uſe of ſpirits. All theſe have a preſent temporary effect, in whetting the appetite, aſſiſting a more languid digeſtion, and augmenting the circulation. But when that effect is over, it leaves the natural powers of life as much ſunk below the natural mark, as it raiſed them for a while above it.

BUT before I diſmiſs this part of my ſubject, I muſt touch a little more particularly on the general cauſe of the encreaſed frequency of infant-mortality.

CHAP. XIII.

Of the Cauſe of the encreaſed Frequency of Infant Mortality.

WE are all born mortal; but the death of infants, though no doubt comprehended in the plan of infinite Providence, is no part of the plan of Nature, more than violent or accidental deaths are. All infants are born to live, and rarely bring into the world any defect of conſtitution to occaſion their early death. That is a large and melancholy roll, to be charged to the account of involuntary miſmanagement and ignorance of the conſtitutions of children, both in health and in ſickneſs.

IF infants require ſweetened aliments at all, the mother's milk is certainly the proper ſtandard, beyond which no food that is adminiſtered to them ought to be dulcified. Children, who are nurſed by a healthful mother, or proper nurſe, need little or no food, but what they draw from the breaſts, for ſome months. The longer they are kept to that, as their only or principal nouriſhment, the ſtronger and more vigorous their conſtitutions become.

In ancient times, when women had almoſt none but domeſtic engagements upon their hands, children were rarely weaned, till they either gradually weaned themſelves, or till the mother's attention was awakened to a freſh object of her maternal ſollicitude and care. Now cuſtoms are greatly changed; I cannot indeed ſay, in this reſpect for the better; but the diſſipation of the men is chargeable with this folly, in the firſt inſtance: For if they ſought for their happineſs more at home, the women would rarely ſeek their's abroad. But however, when mothers do not nurſe, many circumſtances render it dangerous,

ous, particularly in great cities, to employ other nurſes, eſpecially abroad. For theſe reaſons, children are treated as little and as ſhort while with their natural food as poſſible, if they are indulged with it at all; and thus the tragedy of infanticide begins.

When then the infant cries from gripes,—it is hungry, and ſome ſpoon-meat is adminiſtered, as ſweet generally as that delicious poiſon ſugar can make it, which, by that bribe, it ſwallows greedily.——Till the freſh-taken viands begin to ferment, the child is quiet,—not becauſe its hunger was aſſuaged, but becauſe the acid which occaſioned its pain, is ſheathed and diluted by what it has taken; when that likewiſe begins to ferment, the cauſe of its pain, and its crying, recur with double violence; and then freſh materials for encreaſing and ſharpening the acidity is thrown in. Thus, in the firſt place, the child's ſleep, upon which it ought to digeſt and thrive, is broken and interrupted with pain, the child having no intervals for it, but in the ſhort ſpaces between receiving freſh food, and the time of its turning to vinegar in its ſtomach *.

THIS acid not only curdles the milk in the ſtomach, in ſuch a manner, as to congeal the colloſtrum or curd, into tenaceous coherent lumps; but in paſſing from the ſtomach into the inteſtines, it corrupts the bile, which was intended by its alkaleſcent acrimony to

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* They have very imperfect ideas of the nature of our animal digeſtions, who think they can be performed without a due quantity of acidity, or who imagine there is no acidity where the ſenſes do not diſcover it: from whence do ſuch phyſiologiſts ſuppoſe, comes the ſaturating acid of the neutral ſalts of the blood? A ſtrong bias to acidity, often lurks in ſubſtances which diſcover none to the taſte. A chyle of ſuch quality, muſt conſtitute a weak imperfect blood.——Though no acid is diſcovered in the blood, yet does not the abuſe of acids ruin many conſtitutions, who imprudently indulge in the uſe of them, to preſerve the ſhape, and prevent or cure corpulency?

aſſiſt digeſtion, or it renders it inſipid, by the acid ſheathing itſelf as much as it can with its alkaleſcent parts. The bile thus mixed and overpowered with the acid, becomes green, a ſure ſign of its having become vapid and unfit for digeſtion; and therefore it is purged off, mixed alſo with the white indigeſtible curd, a ſenſible interpretation of the cauſe of the infant's ſufferings and pains.

NOTWITHSTANDING all this, the tragedy proceeds.——The infant's bowels become weaker and weaker, their original native dewy humidity is changed into viſcid ſlime, which obſtructs the orifices of the lacteals and abſorbing veſſels daily more and more. ---The corrupted bile, the curd, that viſcidity and any natural recrements of digeſtion which are in the paſſages incorporate, and are baked together into a gluey conſiſtence of a clay colour, which the weak inteſtines cannot expel:

pel:——their efforts to do it, throw the whole infantile frame into convulſions, which ſoon finiſh the tragedy.

At other times, the infant's bowels are ſo weakened and rendered ſo irritable by the above cauſes, that it is thrown into colliquative purgings; by which, not only its food runs through its bowels undigeſted, but its own fluids are drained off alſo, till its vitals are exhauſted, and it is left an emaciated corpſe.

By another as certain, but ſlower road to death, the deadly quantity of acid kept up in the infant's bowels, enters the lacteals imperfectly ſaturated, coagulates the chyle and the lymph it mixes with in the meſenteric glands, obſtructs them thereby, and renders them impermeable and ſchirrous: the child emaciates, its belly ſwells with groſs impaſſible vapours, diſtending its inteſtines, and it dies ſometimes with and ſometimes without fits.

THESE are ſome of the moſt palpable progreſſes of this cruel acid, ſo fatal to infants. But though they eſcape theſe and the like direct effects of it, how often does it weaken their conſtitution, ſo that they either fall ſacrifices to the firſt accidental, or the firſt epidemic diſeaſe incident to children, that they are attacked by, or become ricketty, ſcrophulous, and pine away under cachectic diſeaſes?

THEY have many eſcapes, under the preſent ſyſtem of rearing infants, who arrive at manhood or womanhood; and they eſcape well, who bring no more with them to that æra, but nervous or hyſterical conſtitutions.

CHAP. XIV.

Of the immediate Source and Seat of animal Heat.

I HAVE already diſcourſed of the fountain of life, conſidered as the internal directing principle of both conſcious and inconſcious, or of animal and natural life, in the whole, and in every individual organ and part of our ſyſtem, according to their ſpecific natures and ſimilarities. It is now requiſite to aſcertain, where immediately, that quantity of motion, in that animating element of our frame, is generated and ſupported, that is neceſſary to qualify it for exhibiting all the ſymptoms and phœnomena of life.

ACCORDING to the different natures of different animals, there is a certain general ſpecific degree of activity proper to each kind, in which that fluid muſt be kept, to enable it to diſplay all its functions, and act obediently to the ſeat of influence, thro' the whole ſyſtem of each individual. The nature and quantity of this motion, of that moiety of the matter of light, or fire, which acts as the principle of vitality in every creature, according to its different nature, is aſcertained by its degree of ſenſible heat. The queſtion therefore is, where? In what part of our frame? In what viſcus, or in what ſyſtem of our materials is this elaboratory, in which is fed, preſerved, and kept up, this flame of life, this vital heat?——I anſwer, in the blood.

THERE can be little doubt, but, that the fountain of heat, where-ever that is, and the fountain of vital motion, in the animal ſyſtem, are the ſame.

THE ancient but exploded phyſiologiſts of the Peripatetic and Galenical ſchools, were very nice and ſubtile in their reaſonings upon the ſubject of the *callidum innatum,* or the native heat in animals, which they diſtinguiſhed and ſubdivided into no leſs than ſix heads. Perhaps we now think there was more ſubtilty than utility in theſe refinements, and that they would have ſped better in medicine, had they confined their reaſonings to experiment and obſervation. But upon the whole, I do not find that theſe antiquated phyſicians were either leſs ſucceſsful practitioners; or, in their phyſiology, more frequently obliged to have recourſe to occult qualities, than the moderns. Facts ſeem to have been as carefully attended to by them, as by us; and if they made fewer experiments, they at leaſt made as profitable an uſe of theſe they did make, as we do of ours *.

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* There is a manner of citing and appealing to *facts*, become very faſhionable, among people too, who pretend to be friends to ſcience, as if they excluded

No ſolid or body, whoſe conſtituent parts keep a permanent relative connection with one another, can either generate or retain heat in itſelf. A ſolid continuing ſuch, or, after fuſion by heat, returning again to ſolidity, may be heated paſſively, but it cannot retain heat, far leſs can heat originate in it *.

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cluded reaſoning upon them. Such people muſt have very imperfect ideas of the nature of facts, and of their ſubſervience to knowledge of any kind.——No abſolute facts fall within the obſervation of creatures. All facts diſcloſed to us are relative, ſyſtematic or mechanical, and therefore contain always a double reference; as effects to their cauſes, and as cauſes to their effects. In the ſame manner as every link of a chain, except the terminating ones, is always immediately connected with other two.

* We have many and various inſtances of fluids generating heat in themſelves, but not one of a ſolid's doing ſo. We may as well attribute the heat of hot ſprings to the heat of the rocks the water may happen to paſs through the fiſſures of, as attribute the heat of the blood to the pipes or veſſels it flows in.

It ſeems evident to me, from the reſiduums of both Bath and Briſtol hot waters, which contain a conſiderable proportion of unſaturated alkaline earth in them, that, ſo impregnated, they muſt paſs through veins of ſulphur, or

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If this circumſtance had been attended to, it would have ſaved enquirers many experiments and ingenious conjectures, made in order to diſcover what it determines.—If this does not expreſsly prove, that the ſeat of vital warmth, is in the blood; it at leaſt brings us ſo far on the way towards the diſcovery of its ſeat, by proving it is no inherent principle in the animal ſolids, and by obliging us to look for this elaboratory of heat in the fluids.

At the ſame time, it bears ſome teſ-

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of ſome ſubſtances which emit acid ſteams; but not through a ſufficient quantity of that acid, to neutraliſe all the earth in theſe waters. By the effervеſcence between the acids, and ſuch a quantity of the earths as are found formed into neutral ſalts, is probably produced both the heat of theſe waters and their ſparkling, or emiſſion of acid vapour, which cannot extricate itſelf till the waters break out into correſpondence with the common air, but which is generated in all efferveſcence according to the manner explained in my note on Fixed Air, in my diſcourſe on the Cauſes of the Circulation of the Blood.

timony to the ſagacity of the obſolete phyſiology of the Ancients, who determined the *humidum radicale*, and the *humidum influens*, to contribute eſſentially towards the ſupport of the *callidum nativum*.

BUT the circumſtance of mere fluidity, is not more ſufficient than that of ſolidity for conſtituting any body the ſubject of permanent heat. Heat can no more be kept alive in water, or in quickſilver, than in a bone, a ſtone, or a piece of metal. The maintenance of heat neceſſarily depends upon the mutability of the nature of the fluid it acts in, and its power of changing the nature and properties of that fluid, or certain conſtituent parts of it, with ſuch energy, that the act of inverſion or changing the nature of ſuch particles, ſhall generate as much motion in the fluid Light, in performing the change, as was ſpent in bringing the particles changed to that critical ſtate in which the change paſſes upon them.

When this immutation is executed in all the parts of the fluid, the heat generated and maintained in them during the proceſs, would languiſh gradually, and extinguiſh like a lamp without oil, unleſs the fluid was conſtantly fed and repaired with freſh matter, capable of being ſucceſſively diſpoſed into the animal mutations, by the particular degree and kind of heat and motion, into which it is introduced.

The blood, then, and it only, is that ſpecific fluid in the animal conſtitution, which has theſe characters requiſite to conſtitute it the theatre and immediate organ of the ſupport and preſervation of animal heat. It is not only a fluid, that, without the interpoſition of glandular influence and ſecretion, has been changed into blood, from materials that had not theſe properties before, and that is again in a diſpoſition to be diveſted of its character of blood, and of putting on the properties of the ſecretion of whatever organs it is preſented to; but it is in itſelf, a fluid conſiſting of, at leaſt, three different craſes blended together, capable, probably of being reſolved into one another, and yet ſtill conſtituting eſſential parts of blood.

If we add to all this, that it is a fluid kept in conſtant progreſſive motion, and in mechanical, as well as ſpecific internal, motion, we will find all the ſatisfaction and evidence we can deſire given us to conclude, that it is the conſtant generator and ſupporter of that ſpecific heat, in that moiety of the etherial fluid, which, under the influence of its directing fountain in the ſeat of ſenſation and volition, acts as life through our whole frame, according to the various diſpoſitions and ſimilarities of the different conſtituent parts of our compoſition.

THE neglected Ancients made a ſeemingly unaccountable, and probably therefore, deemed by many, a very fooliſh diſtribution of the different parts of the animal ſyſtem, into *hot* and *cold*; calling the Heart, with its Arteries and Veins, the Liver, the Lungs, the Kidnies, the Muſcles, &c. *hot*; and the Bones and Cartilages, the Ligaments, the Membranes, the Brain, the Nerves, &c. *cold*; while they conſtituted the ſkin of a middle temperature between the two. But if we reflect that they founded this diſtinction upon the different colour of the parts, as they exhibited the appearance of the red bloods being more or leſs predominant in them; and if we advert, at the ſame time, that the parts called cold, may paſſively, or by communication only, be kept as hot as the parts where heat was ſuppoſed immediately to reſide, without their poſſeſſing the property of cheriſhing their own heat; then we will perhaps admit, that this neglected diſtinction was not quite ſo whimſical or groundleſs as at firſt ſight we may be diſpoſed to think it.

CHAP. XV.

Of the Nature and conſtituent Parts of the Blood.

AS I have taken occaſion from my ſubject, to determine that primary and eſſential office of the blood, namely, the ſupport, and maintenance of the animal heat; I wiſh I was likewiſe able to ſay ſomething as deciſive of its ſtructure and analyſis alſo. But as I cannot be ſo confident of doing that, I ſhall only preſume to offer ſome thoughts towards aſcertaining theſe points. Both the analyſis, and the ſtructure of the blood, fall each under three diviſions.

I HAVE little heſitation in ſaying, that analytically, the blood conſiſts of phlegm or water, ſalt, and oil.

Of its phlegm, I obſerve, that though it is water, yet it is ſomething more. All aqueous vapour that has a tinge of ſmell, is either mixed with ſome very ſubtile eſſential oil, that cannot be otherwiſe diſtinguiſhed, but by its flavour; or elſe, which I am more inclined to think, the aqueous vapour itſelf, though it has not loſt its character of water, is ſo far changed or advanced towards a change into oil, as to have ſmell. Such is, what is called the *ſpiritus rector* of vegetables.

The ſaline part of the blood, has ſomething well worth conſideration in it. We know, that in a ſound ſtate, all the ſalts in the blood are in a natural ſtate, though a large proportion of the ſalts of our food (I mean our vegetable food,) are either acid or aceſcent *. But the queſtion is, how the acid ſalts we take into the blood are neutraliſed? and from what ſtock of materials in it, are they furniſhed with their alkaline or neutraliſing baſis?——Again, though a neutral ſalt neceſſarily implies the exiſtence of an acid, why are the blood and animal fluids ſo ready to diſcover their alkali, and ſo difficult to exhibit any ſigns of acid? Theſe points well explained, would tend to give more inſight into the animal proceſſes.

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* Indeed, all natural vegetable acids retain annexed to themſelves, an earth equivalent to what would neutraliſe them, yet in ſuch a ſingular manner, as not to deſtroy

Of the animal oil in the blood, it is to be conſidered, whether it is not all of one kind, or at leaſt tending to one height of elaboration; which in my opinion, (I will call it no more,) tends to ſolidity or fixation. When I ſay ſo, I do not forget that the collect-

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deſtroy their acidity. This is demonſtrated, by a very ſimple chymical proceſs, to be the caſe with cryſtals of tartar, which yield a large proportion of alkaline ſalt of tartar.

ed oils in the body have ſome ſmall appearance of a different character from one another. But what I principally refer to is; what is exhibited in the analyſing of oils, where the fire divides them into ſeparate appearances: ſuch as empyreumatic oils, and that which remains fixed in the coal, or *caput mortuum.* Theſe are not to be underſtood to belong to the oils, as animal, or to any one part of them more difficult to riſe than others. But as all cannot riſe together, theſe particles which are retarded by their ſituation from riſing firſt or early in the alembic, by being longer ſubjected to the fire, neceſſarily acquire theſe changes; not becauſe they were naturally heavieſt, but becauſe they were undermoſt, and therefore neceſſarily ſcorched in different degrees.

My reaſon for not including earth as one of the principles of which the blood is compoſed, I have hinted at before.

before: We have no evidence, nor any reaſon to ſuppoſe, that earth exiſts in the blood, in any other form, but either as a neutraliſing part of its animal ſalts, or as an organ of the phlogiſton, when theſe ſalts, probably by the mediation of aqueous particles, are inverted into particles of oils. For that the earthy remains obtained from the coal of a diſtilled quantity of animal or other oil, is not any part of it that was incapable of diſſipation by fire, may be demonſtrated by the total diſſipation of that oil in flame, when burnt by a wick; while the ſame quantity of oil diſtilled in a retort, will leave a large portion of coal, incapable of ever being elevated into flame; which when calcined, will leave a portion of earth, which no fire can either elevate or diſſipate.

Proper infection is one or all of theſe principles of the blood ſubtilized, actuated, and rendered highly volatile, by ſome accidental animal proceſs, which the common powers of the conſtitution acting on its fluids, neither tends to; nor, where ſuch miaſmata are introduced, can it aſſimilate or overcome them. Theſe therefore act as a ferment in the fluids they mingle with, and invert ſome of them into its nature. Juſt as wort, being incapable of reducing the ſpirit involved in yeſt, but at the ſame time, containing in it principles or combinations ſimilar to theſe the yeſt or the active ſpirit in it was produced out of, theſe act upon the maſs, as a ferment, and inſinuating an arrangement of particles and activity ſimilar to its own, it ſpreads its infection through all the particles capable of immutation into the ſame form.

It is highly improbable, therefore, to ſuppoſe, that any poiſon or virulence, except ſuch as is of an animal nature, can communicate proper infection. Other ſubſtances, or their effluvia, may kill where they enter, or poiſon by an improper contagion; but ſuch noxious bodies cannot propagate or multiply themſelves in the animal conſtitution.

THERE cannot be any proper infection in the air itſelf, (unleſs by becoming accidentally loaded with corrupt animal effluvia,) marſh, miaſmata, or in any effluvia that are incapable of aſſimilating animal fluids to their nature. It is impoſſible for theſe to affect the human conſtitution, in any other manner, than as non-naturals. They may produce either ſuch gradual or ſudden changes upon the relative action of our ſolids and fluids on each other, as may diſpoſe them to this or the other morbid conſequence; but they can introduce nothing into the conſtitution, that can act as a ferment. Nature is progreſſive, but never retrograde in her operations: it is eaſy for her to produce ſpirit out of muſt, but ſhe will never revert ſpirit into muſt. Arſenic, or mineral effluvia, may kill ſuch as it reaches, but neither of theſe will ever become contagion in the blood.

As the blood conſiſts of three principles, ſo in its ſtructure as blood, it is known to conſiſt of three diſtinguiſhable parts; namely, coagulum or craſſamentum, ſerum and red colouring particles; much in the ſame manner as the animal ſecretion, milk, conſiſts of colloſtrum or curd, whey, and cream.

That ſome of all the principles of the blood enter into the compoſition of each of its parts, there is no reaſon to doubt. But in what proportion each partakes of the three principles, is not known; nor has it yet become a ſubject of enquiry, ſo far as I know, though it ſeems to me the moſt probable method of attaining that inſight into the myſterious nature of that fluid, that would be of moſt uſe in medicine; for without that, we ſhall not be able to comprehend how a fluid of common principles, arranges itſelf, where-ever it goes, under three ſuch diſtinct forms.

THE coagulum diſtinguiſhes itſelf by two properties from the other parts. Theſe when ſufficiently weighed, and the inferences collected from them which they yield, may contribute to throw ſome light on the ſubject.

FIRST, the coagulum is a part of the blood, which is coaleſcent under the animal degree of heat; and that this coaleſcence is the direct effect of the animal heat, is proved by the encreaſe of it, under an encreaſed degree of heat, as in all caſes of inflammation, or inflammatory fever. The coagulum of the blood being much of the ſame nature with the mucilage of gums, it may be pretty certainly determined to be, a combination of oily and aqueous particles, rendered tenacious by ſome of the ſalts of the blood, in which there is a conſiderable exceſs of aqueous parts; but as the other parts of the blood conſiſt of the ſame principles, and and as the heat in the blood is the cauſe of the combination, it would ſeem to follow, that the coagulum muſt conſiſt of ſuch parts of theſe principles, as are moſt rarefied by the heat of the blood.

THE ſecond diſtinguiſhing property of this part of the blood, ſeems to favour this inference. It is the lighteſt part of the blood. It is plain, that it is lighter than the ſerum, for it ſwims in it. It ſeems alſo pretty certain that, if not always, at leaſt in ſome circumſtances conſiſtent with life, it is lighter than the red particles of the blood: for in all caſes of ſizineſs, or where there is an inflammatory cruſt, it in part riſes to the ſurface above it. It is ſurpriſing in ſome highly inflammatory caſes, how quickly and ſenſibly to the eye the red part deſcends, and is in a manner ſqueezed out of its place, by the coagulum at the ſurface.

One uſe of the coagulum ſeems to be a proviſion of all-provident Nature, to entangle the moſt rarefied parts of the blood always into this ſtate, to prevent their diſtending the veſſels too much, by their expanſion, if they continued looſe, and ſo diſturbing not only the progreſſive motion and the ſecretions, but, perhaps by that means, ſubverting the whole function of the ſyſtem. That the unentangled effluvia in its natural ſtate, does always in ſome degree, and in ſome caſes, remarkably diſtend the veſſels, is without doubt; but that the tenacity of the coagulum, reſtrains it, is alſo ſelf-evident. If then all the moſt rarefied effluvia entangled in the coagulum, was let looſe in the veſſels, it would certainly choak the circulation and animal proceſſes entirely*.

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* The formation, extenſion, and multiplication of the veſſels in the embryo during geſtation, or its ſtate of formation, ſeem to be another great end, to which Nature applies the coagulum of the blood; and it muſt be

The ſerum may be conſidered as much of the ſame nature with the coagulum, under the difference above ſpecified. Its elements are in ſuch a ſtate, that the higheſt heat of the blood conſiſtent with life cannot rarefy them ſo as to make them coaleſce. That it is only the want of a ſufficient degree of heat that prevents it, is demonſtarted by the ſerum's coagulating, when a ſtronger than the animal degree of heat is applied to it, and a certain portion of its aqueous particles evaporated.

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be applied the ſame way, during growth: beſides anſwering the occaſional repairs the veſſels require. We have a kind of demonſtration of this application of the coagulum, in the caſes of wounds and ſores. Though the fibrous part of the blood is a very incorrect appellation of the gluten, merely becauſe it is a ſubſtance that will rope in any direction; yet certainly, when it eſcapes out of, and covers the orifices of divided veſſels; its tenacity expreſsly qualifies it for being ſtretched into new veſſels, by the fluids behind puſhing forwards into it; while it, by its ropy glutinous quality, will be extended without loſing the adheſive continuity of its parts; in the ſame manner as glaſs, under a certain degree of heat, can be blown into ſmall tubes.

Here then, are two pretty nearly equal quantities of the elements of the blood, whoſe moſt ſpecific difference is, that the animal heat brings the one, and cannot bring the other, into a ſtate of gelatinous coaleſcence. While the ſerum preſerves the neceſſary fluidity of the blood, the gluten mingling every where equally with it, entangles its volatile parts, and reſtrains its tendency to expand into a too elaſtic ſtate, by the degree of heat neceſſary to be kept up in it, for the univerſal ſupport of the vital actions through our whole frame.

It muſt not be omitted, that there is ſome difference of colour between the coagulum and the ſerum; though both are tranſparent, yet the former is more ſo; the latter having a tinge of green, which it undoubtedly partakes of from the bile that mingles with the blood.

THERE are three peculiarities in the red part of the blood. 1ſt, Its colour; which I cannot pretend to account for. 2d, It is not a fluid, but exiſts only as a tinging ſubſtance; and thirdly, which is very ſingular, that it is in a manner confined to the gluten, and is almoſt wholely entangled in it. It would ſeem as if ſuch a tenaceous medium as the gluten, was neceſſary to ſuſpend it equally, and to keep it from precipitating or combining into ſome more ſolid form.

WHAT is deſireable to be further known of this part of the blood is, Whether, as the blood in general is the preſerver and propagator of animal heat, it in particular is not the more immediate ſeat of it? This we know, that the heat and colour of any part keep pace with each other; and whenever we ſee the colour of any part of the body heightened, we generally determine, without the neceſſity of feeling in all inflammations, that its heat is encreaſed in proportion.—Whether is it not moſt immediately elaborated out of the bile? This, if it is ſo, would be ſome apology for the opinion of former times, when the liver was ſuppoſed to be the great elaboratory of the blood.—And—— whether are not its particles the moſt predominantly unctuous ones in the blood?

As to the determining aught of the nature and uſe of the red particles, from the examination of their form by the microſcope, or as to the poſſibility of catching any ſingle conſtituent particle by itſelf, ſo as to aſcertain its form, I am in doubt; notwithſtanding the ingenious attempts that have been made that way. They who are curious to know more of this animal principle, ought to find out a menſtruum, which would not only waſh it from the coagulum,

gulum, but which it could be ſeparated from afterwards, by evaporation, as is done in procuring colours from flowers, *&c.* Then it might be put to examination by itſelf.

C H A P. XVI.

Of Irritability, Spaſm, Life.

AS theſe terms have been in modern times adopted into phyſiology, and make at preſent the moſt conſiderable figure in our theory, both of health and of diſeaſes, in ſenſes either ſuppoſed to be formerly unknown, or as alluding to phœnomena in the human conſtitution, that were wont to be underſtood and ſpoken of, in another manner; and as what theſe terms ſeem to allude to, have a direct and immediate connection with the ſubject of hyſterical, hypochondriacal, *&c.* diſeaſes, I find it therefore requiſite to enquire into the meaning and application of theſe terms.

IRRITABILITY.

WE are indebted to the truly learned and indefatigable phyſiologiſt, Dr. Haller, for this term. It is meant, I apprehend,

prehend, to denominate ſome natural property, peculiar to living animal ſubſtances, particularly to their ultimate vaſcular ſolids; too great a degree of which property, conſtitutes a diſeaſed affection of them. The ſenſible idea that the word irritability conveys, is that mobility of any ſubſtance (of a glaſs of jelly, for example,) that manifeſts itſelf, by a tremulous motion through the whole, when it is touched in any part; and it implies a looſe connection of the parts of ſuch a ſubſtance, compared with the firmer compages of any more ſolid body. The idea conveyed by the word, is alſo very properly applicable to a fluid acting in or confined to veſſels, which undulates in all its parts, when the veſſel that holds it is ſtruck.

It is analogous to electricity, in that the electrical fluid, contained in the electrified body, is ſhocked through its whole ſubſtance inſtantaneouſly, on communicating with the conductor. It ſeems to differ from electricity, in that the ſolid itſelf is not apparently moved, by the electrifying of the fluid contained in it. But this is only a ſeeming difference; for in fact, every living ſubject that ſuſtains an electrical ſhock, feels a violent impreſſion made upon its whole ſubſtance.

IRRITABILITY is alſo analogous to elaſticity; but ſeems to differ from it in this reſpect; that the irritation of the ſubſtance of an elaſtic, ſeems confined to the point where it is ſtruck. But this alſo is only a ſeeming difference; for when an elaſtic body is extended and properly attenuated, as in the ſpring of a watch, or in a muſical chord, then elaſticity ſhows itſelf to be preciſely analogous to irritability in its phœnomena.

IRRITABILITY, as applicable to the living animal frame, may be diſtinguiſhed into *inſenſible* Irritability, or that unfelt conſtant commotion of the animal fibres, which is remarkably diſcernible in what is called the vermicular motion of the inteſtines; And into *ſenſible* Irritability; in which the perception is eaſily ſhocked, ſo as to diſturb the whole frame by every accident that affects the ſenſes unexpectedly. This ſpecies of irritability is one conſtant concomitant ſymptom of the hyſterical diſeaſe.

In attenuated ſubjects of irritability, ſuch as animal fibres, it implies a vibration upon irritating contact back through the whole length of the fibre. ——It implies that the fibre itſelf is in a ſtate of tenſion or diſtention ſufficient to brace it, and preſerve it in that conſtant ſtate of elaſtic mobility, which is the characteriſtic of living animal fibres.——An actual ſtate of irritability in living animal fibres, implies a conſtantly influent, active ſubſtance, keep-ing the fibres tenſe,——and it implies an active ſubſtance, that by its motion conſtantly plays upon the fibre, and keeps it moving. All theſe cauſes ceaſe upon death; and therefore upon death, an animal fibre loſes its elaſticity.

It is admitted in fact from obſervation, that the fibres of living animals are in an elaſtic ſtate; for when they are divided, they ſhorten and retract. But moſt phyſiologiſts are more diſpoſed to refer this to ſome occult principle, than to examine what natural or mechanical principles exiſt in the living animal, ſufficient to produce the effect. The animal fibres have all the appearance of being looſe and involved, and not ſtretched between two points, or tight in the ſenſe that a muſical chord is. A cord of any kind can be rendered elaſtic only two ways, either by *tenſion* between points; or by *diſtenſion*, ſwelling their ſubſtance in thickneſs beyond the natural ſize, which in death they collapſe into; therefore in life, there muſt be ſome natural cauſe of their greater diſtenſion.

THE immediate cauſe of this will appear more plainly, when we advert that the fibres of a dead animal may have elaſticity reſtored to them, by the heat of roaſting or boiling. The fibres of a piece of dreſſed meat cut up warm, retract themſelves more ſenſibly and violently than even living animal fibres do: Therefore, it is natural to conclude, that the animal heat, and the other circumſtances of the internal agitative and progreſſive motions of the fluids in them, and of the etherial fluid in both, are what give elaſticity to the fibres of living animals; or rather is, what in them conſtitutes their elaſticity. Therefore, it muſt be an inferior degree of elaſticity, as I have noticed before, that encreaſes the irritability of animals, ſo as to render it a diſeaſe.

THAT degree of irritability conſtituting a diſeaſe, ought to be remedied either by *depletion*, by which the tenſion is relieved; by *incaleſcence*, adding ſtrength and competent action to the fluid, whoſe weakneſs moſt immediately produces morbid irritability; or by *condenſation*, encreaſing the firmneſs and contractile quality of the ſolids themſelves.——The judgement of the phyſician muſt diſcover which of the modes of aſſiſtance each conſtitution requires.

IRRITABILITY may, with propriety enough, be diſtinguiſhed into ſolid, viz. as it is diſcovered in elaſtic bodies; and ſemi-fluid, viz. ſuch as manifeſts itſelf either in jellies, or ſuch as is diſcoverable in ſubſtances compoſed of a mixture of ſolids and fluids, like living animal ſubſtances: Therefore the way to diminiſh the latter ſpecies of irritability, which is the greateſt, or at leaſt the moſt ſuſceptible of agitation from ſlight cauſes, is to ſtrengthen the parts both ſolid and fluid, ſo as to make them approach nearer the conſiſtence and firmneſs of the former. ——In how many things do mechanics inſtruct the phyſician? *Q.* What are the ratios of the mechanical proceſſes of dreſſing leather? *Q.* What is the reaſon that fire, which is known to expand all bodies, ſhould ſeem to ſhrivel many bodies when they are caſt into it, ſuch as Cloth, Paper, Parchment, *&c. &c.?*

SPASM.

THE phœnomena to be attended to in medicine, and which it is requiſite every intelligent phyſician ſhould form ſome adequate conception of, in order either to his aſſiſting and ſupporting nature, or relieving it with propriety, are perhaps ſome of the moſt obſcure in nature, and therefore have little need to be perplexed with vague and indefinite terms.

THE etymological ſenſe of the word *Spaſm*, is much the ſame with that of *attraction*; and, of late eſpecially, it has been uſed much in the ſame looſe indeciſive manner, to denominate occult powers, the nature of whoſe action it not only does not define, but of which it gives us either incompetent or falſe ideas.

FORMERLY, in medicine, the term *Spaſm* was appropriated to denominate the involuntary, painful action, or contraction of muſcles, or muſcular fibres; and as ſuch, it became a very diſtinct head for the arrangement of a certain ſeries of diſeaſes under it, produced either by irritation, (which is diviſible into *repletion* or *acrimony*,) as in the caſes of Epilepſies, Wounds, Worms, Dentition, Acidities, and Coagulations, Obſtructions of the firſt paſſages, *&c.* *&c.*——or produced by a decay, or conſtitutional weakneſs, or irritability of the habit, ſuch as hyſterical, hypochondriacal,

driacal, *&c.* diſeaſes, many aſthmas, autumnal *, and bilious complaints, and various morbid phœnomena occuring in cold, relaxed conſtitutions, or conſtitutions exhauſted by intemperance of any kind.

As I am upon this ſubject, I ſhall take the liberty, which I flatter myſelf, will not be objected to, of digreſſing ſo far from proſecuting the ſubject phyſiologically, as to offer ſome practical marks for diſtinguiſhing ſpaſmodic from inflammatory pain. This is a point I do not remember to have ſeen ſo particularly attended to, as its importance requires. As Spaſms in nervous ſolids, and parts whoſe action and motions are not ſenſible and voluntary, like thoſe of the muſcles, cannot be by the ſenſe diſtinguiſhed from pain ariſing from other cauſes; yet, as they ought to be treated very differently, it is, I apprehend, a matter of much conſequence, to attend to the following ſhort and preciſe marks, for diſtinguiſhing ſpaſmodic from inflammatory pain.

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* Under what are called autumnal complaints in northern climates, are to be included all ſimilar diſorders in equatorial climates, where the heat is always nearly the ſame.

SPASMODIC pain, let it be ever ſo exceſſive, ſeldom or ever excites general convulſions, whereas an extreme degree of inflammatory pain is very apt to produce them.——Spaſmodic pain is often deſultory and wandering; when any noble or vital part is oppreſſed with it, it is generally relieved by a tranſlation of the pain or ſpaſm, to ſome leſs vital part; whereas inflammatory pain never ſhifts, till it is relieved either by reſolution, ſuppuration, or mortification of the part.——Spaſmodic pain is generally attended with a low, ſmall or ſometimes languid pulſe, and with little or no fever: inflammatory pain, is always attended with a conſiderable degree of fever, proportioned to the magnitude or quantity of the inflammation, unleſs the ſeat of it is in ſome part which immediately affects the free action of the nervous ſyſtem.——When inflammatory pain terminates in mortification, the mortification is confined to the ſeat of the inflammation, or at leaſt commences there: but ſpaſmodic pain of the ſame fatal tendency, generally ſpreads an univerſal langour over the whole vital ſyſtem, and is apt to produce an univerſal ſtagnation of the circulation, and death of the other members, almoſt as ſoon as in the original ſeat of the pain itſelf.

In modern phyſiology, by, I cannot help calling it, a very unjuſtifiable proſtitution of terms, Spaſm is uſed as a term of indefinite application, not only to ſome unintelligible actions of the ſolids of living animals, but to the very action of objects upon our ſenſes. Two different colours cannot make more

diſcrete

diſcrete impreſſions on the ſenſible fibres of the eye, than heat and cold do upon the ſentient cutaneous nerves; yet by the preſent phyſiology, both are not only indiſcriminately confounded under the denomination of Spaſm; but the one, according to the preſent theory of fevers, is interpreted a continuation of the other; as if the rigidity or tenſion impreſſed on the cutaneous veſſels by febrile or an unnatural degree of heat, was merely a continuation of that corrugation which the ſenſe of cold produces on the nerves of the ſkin. But as I ſhall treat of this ſubject in the ſubſequent part of this work upon the nature of fevers, I ſhall not purſue it further here. An endleſs maze of illuſions may be conjured up in any ſcience, by tranſpoſing cauſes into effects, and effects into cauſes; and by explaining phœnomena which have their eſtabliſhed unvariable cauſes, ſuch as theſe actions, whether of the ſolids or fluids, which depend on our ſenſations, into incomprehenſible actions of ſome unknown power called *life*, excited in it by ſome as unintelligible cauſe.

It is not eaſy to trace phyſically, in ſuch a complex ſyſtem as ours, where there is every where ſuch a reciprocal action and re-action, and ſuch a concurrence of various circumſtances conſpiring in the producing and ſupporting every effect, the preciſe origin or nature of almoſt any ſingle phœnomenon belonging to our conſtitution; but it is always poſſible to attain ſo much accuracy in theſe matters, as to enable us clearly to diſtinguiſh the nature of one action from another, and to make ſuch an application of terms to things or actions which can be diſtinguiſhed from one another, as ſhall preſerve us from running into perplexity and confuſion in our ideas of things.

As *irritability* then and *ſpaſms*, are two ſymptoms that always accompany either hyſteric, hypochondriac, or nervous diſeaſes, I ſhall endeavour, in a few words, without further diſcuſſion of the phyſical cauſes of either, to eſtabliſh ſuch a diſtinction between the one and the other, as may be of ſome practical uſe, and ſerve as a criterion for diſtinguiſhing theſe ſubtile proceſſes in our frame from each other, at leaſt as diſeaſes.

The one, namely *irritability*, ſignifies, or ought to ſignify, that mobility of our ſyſtem of ſolids and fluids taken complexly (for I can in no poſſible caſe conſider them independent of one another in any one vital or animal function) by which external impreſſions re-act upon the ſeat of ſenſation or perception. *Spaſm* is an involuntary impreſſion from the ſame ſeat of ſenſation upon the inſtruments of voluntary motion, the muſcles, and muſcular fibres, where-ever they are ſpread; and it always (excepting in caſes of violent irritation) implies the equilibrium loſt between the ſolids and fluids, from a decay of the vigour and animal warmth of the latter.

LIFE.

Metaphysically, this term ſignifies that whole ſyſtem of conſcious powers which can be ſuppoſed and underſtood to have an exiſtence independent of matter and mechaniſm, though we know not how.

Physically, *life* ſignifies that ſyſtem of materials, mechaniſm, combinations, and that ſyſtem of motions, actions, &c. reſulting therefrom, which characteriſes ſuch a ſyſtem of materials phyſically alive, that is regular and conſtant in the performance of a ſeries of natural, vital, and animal functions and operations; the diſorder, weakening, &c.

of which, in whole or in part, conſtitutes a diſeaſe.

In a mixed ſenſe, that is, in beings compoſed of a combination of mental and material properties and actions, the term *life* comprehends all that influence which theſe two parts of our compoſition have upon each other.

These diſtinctions being properly regarded, will eſtabliſh a clear and diſtinct idea to the term *life*, when it is uſed in phyſiology; and the neglecting of them muſt render the meaning of the term full of obſcurity. Who can comprehend what our phyſiologiſts mean, when they apply the term *life* to a fluid or fibre of our conſtitution? nay, even to one or other of theſe, for ſome time after they are detached from it? I can eaſily ſuppoſe that ſome of theſe material motions which belong to phyſical life, may, for a little ſpace of time, belong to a member or to a moiety of a fluid, after it is disjoined from its whole, or may retain for a little ſome of the properties belonging to the animal combinations of its parts; but more than this, it is not poſſible to comprehend. Though elaſticity, irritability, the power of ſpaſmodic contraction, &c. form part of the properties of the animal materials, it does not follow that the term *life* is more properly applicable to theſe phœnomena of bodies in their animal ſtate, than out of it; merely becauſe in their animal ſtate they ſtand in connexion with other circumſtances, which all taken conjunctly, conſtitute, in whole, *phyſical life* *.

CHAP.

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* I am afraid that a falſe intemperate ambition for making diſcoveries, and an irrational affectation of treating even mechanical facts, as not the ſubjects of reaſoning, have contributed largely to the multiplication of myſteries in both Phyſics and Phyſiology. It is not enough that we have adopted into phyſiology, Life, an occult quality which matter acquires in conſequence of being aſſumed into the animal ſyſtem; but that myſ-

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C H A P. XVII.

Of the Indications of Cure in Hyſterical Diſorders.

BEFORE the reader ſhall have advanced thus far in theſe diſcourſes, he muſt have diſcovered, that it has not been my intention to write a practical treatiſe

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tic principle muſt have its myſtic effects too. We are informed in the laſt volume of the Philoſophical Tranſactions, that—Life has a power of producing cold—This is ſuch a novelty in phyſics as few would have dreamed of indeed. But wherein is this peculiar to life? Every body has a power of communicating a moiety of its coolneſs to any other body hotter than itſelf, that is brought within the atmoſphere of its influence. Why ſhould it not add to the myſtery, that every hot body that is cooled by a colder one, is, in return for the coolneſs it communicates, heated as much as the hotter body is cooled?—Cold water and hot water mixed together, in equal quantities, will make tepid water. If this is a myſtic property of living bodies, is it not as much a myſtery in dead ones? It brings to my remembrance treatiſe on this diſeaſe, and to inform the public what courſe I would take with hyſterical patients, or what recipes I would write for them; far leſs to pretend to inſtruct others how they ſhould treat them. My deſign muſt diſcover

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membrance a ſimilar retrograde myſtery in phyſics— When a billiard ball is impelled againſt another at reſt, the motion paſſes out of the moving one into the one that was at reſt, and the reſt paſſes from the one that was ſtruck into the one that ſtrikes, and arreſts it— In other words, they make a fair exchange of their oppoſite *vires inertiæ*.

I muſt take the liberty to add here a very obvious inference from the experiments made upon the Heated Room, that have been ſo much talked of among the curious of late.—The heat which denſe and ſolid bodies, ſuch as ſtones, metals, &c. acquire in an atmoſphere, is no gage for the heat of the atmoſphere itſelf. I fancy few are ſtrangers to this fact—that ſtones or metals expoſed long enough to the rays of a warm ſun, in the common air, will become too hot to be handled. This will contribute to explain that puzzling circumſtance mentioned by one of the gentlemen who proſecuted theſe ingenious experiments, who could not in whole, nor even in part, coagulate the white of an egg, except when it was put upon metal.—He may aſſure himſelf, it was not the life that was in the albumen that reſiſted its coagulation.

itſelf throughout, to have been the propoſing ſome views relative to that diſeaſe, relative to the female nature and conſtitution in particular, and relative to the human conſtitution in general, which have not been much attended to, or proſecuted; and which, if juſt, may be of general uſe, not only to the phyſiological, but to the practical improvement of medicine; eſpecially that branch of it which relates to the management of the female ſex, ſuitably to their importance, and the many accidents and dangers their conſtitutions are expoſed to, which theſe of men are not.

From the different cauſes, conſtitutions, periods of life, &c. which contribute to the exciting and irritating of the hyſterical diſeaſe; from the difference of its degrees, and the different ſources of its ſymptoms; it is plain no general uniform plan of treatment can be laid down for it.—At ſome times, it is to be ſoothed; at other times, it ought to be ſubdued by evacuation or revulſion; while other caſes require bracers, or tonics.—Some caſes require medicine, and others only a proper regimen of the non-naturals.—In ſome caſes, it is requiſite to pay a direct attention to the ſymptoms, according to their urgency; in other caſes, theſe are to be neglected, and we ought to addreſs ourſelves only to the cauſe.—Sometimes, it is only neceſſary to attend to the ſtate of the firſt paſſages; at other times, a regard is to be had to the whole habit of the body.—In moſt caſes, the intention of cure ought to be complex.—In all caſes, the ſtate of the ſkin, and an equal diſtribution of heat over all the ſurface of the body, with a regular ſtate of the organs of digeſtion, are always primarily to be regarded.

SOME people, by miſtake, apprehending that the diſeaſe proceeds always from poverty or imbecility of conſtitution, think they contribute to their own cure by ſuch diet as is eſteemed moſt nouriſhing and reſtorative; but in that they are often greatly miſtaken; what is plain and of eaſy digeſtion, often contributing incomparably more to the cure; but in all caſes, the quantity of diet is of more conſequence than the quality of it. If in this, as in moſt chronical diſeaſes, people could regulate their diet, ſo as to be often hungry, and never very full, they might be their own phyſicians.

ONE thing I muſt take the liberty to obſerve; in very few caſes of the hyſterical kind, are theſe hot ſtimulating medicines, commonly called Uterine, Emenagogue, or Antihyſteric, indicated; and in any caſe where they are proper, Aſſa-fœtida is ſufficient to ſupply the place of all others; it being a medicine of great uſe, not only out of the paroxyſms, but during the attacks of them. It is generally improved by being accompanied with laxatives, or abſorbents, according as either or both are indicated; one or other of them being almoſt always requiſite during the continuance of hyſterical ſymptoms. Where this diſeaſe is complicated with ſcorbutic acrimony, Gum Guaiac, properly managed, is an excellent medidicine, ſuited to both intentions.

C H A P. XVIII.

Of the Diſtinction between Hyſterical and Nervous, or Hypochondriacal Diſorders.

AS nervous and hyſterical diſeaſes, though in fact very different, have the appearance of ſomething congenial in them, and a great ſimilarity in many of their ſymptoms, I think it requiſite, before I cloſe this ſubject, to add ſome reflexions on the former, to what I have ſaid on the latter.

VAN HELMONT, notwithſtanding his ſingularities, was certainly a very great man, of a penetrating genius, and deep reflexion. It was, no doubt, on account of the remarkable ſympathy and intercourſe that he obſerved between the ſtomach and the head, the ſeat of both the conſcious and inconſcious fountain of life, that, in imitation of the allegorical genius of the Ancients, he gave a perſonality to his *Archeus*, or preſident of digeſtion, ſeated at the upper orifice of the ſtomach.

There certainly is a very notorious reciprocal ſympathy between the ſtomach and the head; and anatomiſts diſcover a very rich diſplay of nerves about the upper orifice of the ſtomach. The uterus only excepted, no part of the human conſtitution communicates with the head as it does. It alarms the head with its diſorders, and in a manner provokes it to its aſſiſtance under all its uneaſy ſenſations, pains and oppreſſions; and this ſeems to be the obvious reaſon, why there is ſuch a general ſimilarity between the ſymptoms of hyſterical and hypochondriac or nervous diſorders. I call theſe ſynonimous, becauſe wherein they may be ſuppoſed to be diſtinguiſhed, the difference is only in degree.

THE ſtomach is certainly the immediate cauſe of all theſe ſymptoms, commonly called nervous, or hypochondriac. They all derive their ſource from a weakened viciated digeſtion; from the undue fermentation, or corruption of the aliments, and of the ſecretions that ſhould miniſter to their digeſtion in the firſt ſtage of their paſſage through the bowels. When this diſorder of the ſtomach gathers ſtrength, and becomes habitual, it neceſſarily draws all the other parts of the inteſtines and their connexions into conſent with it; and hence theſe viſcera become afflicted with irregular pains, ſpaſms, diſtenſions, flatulencies, &c. in different parts of them. Theſe are generally attended with great irritability of the nervous ſyſtem, great lowneſs and inequality of the ſpirits and temper; fears, uneaſy ſenſations, imaginary diſeaſes, or apprehenſions of dangers from their complaints.

So far, or rather a little below this ſtate of the diſeaſe, it is commonly called nervous; but if it advances beyond this; if the patient is afflicted with violent heart-burnings, irregularities of the appetite, great coſtiveneſs, black bilious vomitings or purgings, involuntary ſpaſms, and twitchings in different parts of the body; or, if ſuperadded to theſe, he is invaded by faintings, convulſive tremors, frightful and diſmal ideas, a delirious imagination, or exceſſive inequalities of the mind, then the diſeaſe is commonly called either the hypochondriac diſeaſe, or an atrabilous melancholy.

The primary remote cauſe of this diſeaſe is either a natural weakneſs of the inteſtines, or ſome diſeaſe fixing upon them; rendering them weak, debilitating or viciating the digeſtive faculty, and the ſecretions belonging to it; by which means, the ſolids, loſing their equilibrium with the fluids, become more and more overcharged, and in ſome meaſure oppreſſed by them. In this caſe, the ſymptoms of the diſeaſe rarely aſcend beyond the ſtandard of what are commonly called nervous complaints.

If the diſeaſe is not owing directly to the preceding cauſe, then it muſt be referred to a difficulty in the circulation of the blood through the liver, by its being either obſtructed or weakened; or elſe from too great a viſcidity or other diſorder in the blood, retarding its free paſſage through the liver. In any of theſe caſes, all the digeſtive bowels become oppreſſed in their natural powers and functions: for the blood, in its return to the heart, paſſes from the inteſtines into the liver; and they muſt become loaded and diſabled for their different offices, if the liver, which receives the blood from them, paſſes it with difficulty, from whatever cauſe.

THE ſecondary remote cauſe of all theſe ſymptoms muſt be referred to ſome ſuppreſſed evacuation, particularly of blood itſelf; ſuch as the want of a conſtitutional, hemorrhoidal, or menſtrual diſcharge, or a ſuppreſſion of any habitual bleeding at the noſe, *&c.* or elſe, which is too frequently the caſe, it muſt be referred to ſome ſpecies of latent acrimony in the blood (commonly called the Scurvy, of whatever kind it is) which has either been injudiciouſly repreſſed, or which Nature cannot muſter forces ſufficient to expel by ſome critical diſcharge.

FROM this detail of the diſeaſe, even a perſon of moderate judgement in phyſic, may make the two following inſtructing inferences. 1ſt, That there can be no perfect cure of this diſeaſe, without ſtriking at the ultimate and moſt remote cauſes of it, and remedying them; which muſt be a work of time. 2dly, That the more early the diſeaſe is attended to, before it has taken too deep root in the conſtitution, the greater hope there is not only of curing it, but of curing it ſooner than can be done after it has ſapped the conſtitution by the ravages its various ſymptoms have made in it.

In the advanced ſtages of this diſeaſe, it is impoſſible to put perſons ſubjected to it upon a ſafe plan of ſelf-management, or to lay down rules for piloting themſelves through the perplexities both of body and mind which it occaſions. But in theſe lower degrees of it, which are ſo common to both ſexes, it would be eaſy for them, if they had the command of their own inclinations, to annihilate the diſeaſe by a proper attention to, and management of themſelves.

As this form or degree of the diſeaſe prevails principally among younger perſons, a little medicine, and an exact management of themſelves, are all that is neceſſary. It frequently happens that the temporary curing of ſuch complaints by medicine only, (which may be done), if no attention is paid to the management of diet, pleaſures and exerciſe, either at the time or afterwards, terminates only in the return of the diſeaſe ſoon after, with greater violence and obſtinacy. When perſons find themſelves ſuddenly, eaſily, or unexpectedly relieved, they are tempted to plunge themſelves again into an irregular courſe of living, ſo that in a ſhort time, they find it had been better that they had not thought themſelves ſo completely cured.

Hot medicines never agree with young conſtitutions; they tend to encreaſe the fire natural to their age, which ſhould be abated rather than fed; even the Bark, which is the cooleſt of almoſt any ſtrengthening medicine, is too much for them, without being tempered by laxatives, abſorbents and neutrals. A tea of the Bark, of Camomile Flowers, Gentian, or Centaury, or of all theſe mixed together, taken twice in the day, with half a drachm of Magneſia*, or a drachm of Soluble Tartar, or of Vitriolated Tartar, will have a happy effect on a young conſtitution in very bad repair, if moderation is obſerved both as to the quality and quantity of what is ate and drunk; as vinous or ſpirituous infuſions of hot ſtomachics, aromatics, and other irritating nervous medicines, would enrage inſtead of alleviating every ſymptom of the diſeaſe.

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* This for ſome time has been a faſhionable medicine, merely becauſe it is the abſorbent we have become moſt lately acquainted with; therefore various attempts have been made to ſpoil it, by an affectation of peculiar nicety in the preparation of it. It will not purge at all (notwithſtanding what has been ſaid to the contrary) if either by exceſs of waſhing, burning, *&c.* the neutral ſalts are wholly ſeparated from it. I have known it prove violently binding by this method, and conſequently become hurtful to both old and young. Too much of it alſo (even though not ſo ſpoiled) is not good for infants of very weak habits, who cannot bear an exceſs of neutral ſalts: it cools their blood too much; therefore, when continuance in the uſe of it for ſome time becomes requiſite, it ſhould always be properly qualified.

BUT to prevent miſtakes, which too frequently happens, in deciding upon the complaints of young people, eſpecially males, let it always be remembered, that an overfullneſs of habit will often produce individually the ſame ſymptoms that are too generally and uniformly attributed to weakneſs, relaxation, debility of the nervous ſyſtem, and coldneſs of the conſtitution. Similar ſymptoms are often excited by oppoſite cauſes, and an error of judgement in ſuch caſes is an unhappy accident for the patient.

SUBSTANCE

OF A

LECTURE

Delivered at NEWCASTLE, 28th DECEMBER, 1773, on the NATURAL POWERS employed in the CIRCULATION of the BLOOD, independent of the ACTION of the HEART.

——— I NEED ſcarcely do more than mention to you, that a muſcle is a compoſition of animal fibres which have a power of contracting and conſequently of moving themſelves, and whatever is connected with them; and that the heart is ſuch a muſcle, or rather collection of muſcles.—The arteries are theſe veſſels that carry the blood from the heart to all the parts of the body, dividing conſtantly off from one another, like the branches of a tree, till they terminate in the greateſt conceivable tenuity.—The veins which bring the humours back again from every part of the body, begin in the ſame attenuated ſtate as the arteries ended in; and as they unite, they enlarge, till they meet in one great trunk or vein, which brings the blood back to the heart again.—The heart itſelf conſiſts of four chambers, or rather of two pair of chambers, each pair conſiſting of an outer and inner one.—Each of theſe chambers is to be conſidered as a diſtinct muſcle, or muſcular bag, which has a power of contracting itſelf ſeparately.—Into the outer chamber of the right ſide, or more properly the fore ſide, of the heart, the great vein I mentioned, called the Vena Cava, opens and pours in the blood. When that outer chamber, commonly called the right auricle, is full, it contracts by its muſcular force and empties itſelf into the inner chamber, called the right ventricle; which, when it is filled, alſo contracts and injects its contents into an artery called the pulmonary artery, which by its diviſions and attenuations ſheds the blood through the whole ſubſtance of the lungs.

In the ſecond pair of chambers of the heart, the like proceſs is tranſacted over again. The incipient and imbibing veins take in all the blood diffuſed through the lungs by the arteries, and uniting their forces as they meet, terminate all at laſt in one great vein, called the pulmonary vein, which unloads itſelf into the outer chamber of the ſecond pair of rooms, called the left auricle of the heart, which, when filled, contracts and iſſues its contents into the inner chamber, called the left ventricle of the heart, which when it is full, contracts alſo, and diſcharges itſelf into the great artery, called the Aorta; which branching off, and ſeparating into infinite ſubdiviſions, both in regard to their number and tenuity, diffuſe the blood in form or in ſubſtance to every organ and ſpot in the animal ſyſtem.—I need only obſerve further to you, in order to your diſtinctly conceiving the actions of the heart above ſpecified, that, each chamber is furniſhed with a complete ſet of valves, which, when the chambers contract themſelves, exactly ſhut and preclude any of the blood from being forced back again by the way that it entered.

FROM this hiſtorical account of the perpetual tranſactions of the heart, you muſt diſtinctly perceive, that in the ſubſequent diſcourſe I do not pretend to diſprove that it is by the action and force of the contractions of the heart that the blood is thrown out of it into the arteries: But I propoſe to demonſtrate, that theſe actions have little or no concern in ſupporting the progreſs of the blood along the finer arteries, after it is thrown into the great ones, and ſtill leſs, in having any ſenſible influence on its motion through the veins back again to the heart.

THE circulation of the blood, as above-deſcribed, was no ſooner aſcertained by the celebrated and learned Dr. Harvey, than the force and energy of the muſcular contractions of the heart was firſt univerſally ſuppoſed, and then admitted and acquieſced in almoſt implicity, as the only conſiderable moving cauſe of the whole: And this, with few variations or additions, continues to conſtitute the ſum of the doctrine of the circulation, from the æra of Dr. Harvey down to the preſent time.—The nature of this diſcourſe does not require that I ſhould enter into any particular detail of all that has been ſuggeſted or ſaid upon the powers of circulation. I ſhall take notice of ſuch particulars as I know, or as occur to me, in the courſe of this diſcourſe. If any other author before me, that I may either have not ſeen, or not attended to, has advanced what I may imagine peculiar to my ſentiments and reaſoning in this diſquiſition, I can content myſelf with the originality of my own reflections, without contending for the honour of priority with ſuch perſons *.

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* Since this diſcourſe was delivered to the printer (Jan. 1774.) I have ſeen in a liſt of foreign publications, a treatiſe in Italian expreſsly upon the ſame ſubject, publiſhed at Modena.

By the vigorous contraction of the heart, and the elaſtic or muſcular reaction of the throbbing arteries, then, together with that ſpecies of lateral reſiſtance, from the atmoſphere without us, and what acts as an equivalent to it within us, (without which indeed all motion would languiſh and fail) the blood is ſuppoſed to be urged on to the fineſt filaments of the arteries and glands ; and not only ſo, but to be propelled into the incipient veins, which, uniting their ſtreams, unite alſo their forces in bringing the blood back to the heart again.—As a ſupplement to theſe powers, the late ingenious and learned Dr. Whytt ſuggeſted, with ſome reaſon, the perpetual oſcillations of the finer veſſels, ſqueezing the blood forward in the direction of its progreſs † :—to the aſſiſtance of the motion of the venous ſtreams of blood in the primary filaments of the veins, the attraction of capillary tubes, by which liquors are diſpoſed to riſe in them to certain heights, is ſuggeſted as acceſſary, and alſo the motion of the muſcles everywhere when they act, preſſing the veſſels.

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† That there is a perpetual motion of the animal fibres everywhere, while natural heat remains in the body,

THE firſt ſuppoſition I ſhall ſpeak to by and by—but that laſt is ſo incidental, and the progreſs of the circulation is in ſo many inſtances equally perſiſting when every muſcle is at reſt, that little weight can be allowed to that as a neceſſary and permanent cauſe.

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body, ſomewhat analogous to the vermicular motion of the inteſtines, is pretty certain. It would ſeem to be maintained principally, by the conſtant relapſe, wandering, and re-abſorption of warm active effluvia everywhere; and by the perpetual action of the nerves or ultimate fibres, as after explained, everywhere.

BUT notwithſtanding all the auxiliary ſupplements that may have been occaſionally ſuggeſted, as conſpiring in ſupport of the circulation, ſtill the force and momentum given to the motion of the blood by the muſcular contractions of the heart, has been eſteemed of ſuch importance, and ſo ſufficient for the weight of the charge, that the moſt celebrated calculators, ſuch as Borelli, Sir I. Newton, Keil, Jurin, Hales, Haller, &c. have engaged in the niceſt experiments and calculations to aſcertain with preciſion, the force of the muſcular contractions of the heart,—the quantity of the blood thrown into the arteries by each ſyſtole,—the force and velocity with which the blood is propelled into the arteries, &c.

INDEED the fact of the heart's contractions, and the expulſion of the blood out of its cavities thereby, is ſo certain, and the ſuppoſition of its power for accompliſhing all that is inferred from it, has the appearance of being ſo ſimple, ſo mechanical, and ſo natural, that it is no great wonder the ſubject has hitherto eſcaped a ſtricter and more accurate examination.—What eſcapes the moſt penetrating geniuſes, may ſometimes be ſtumbled upon by very ordinary capacities; which ought to be conſidered as an encouragement to every man's induſtry, let his genius be ever ſo ordinary.

The intention of this ſhort diſquiſition, then, is to prove, that the force impreſſed upon the blood by the heart, is not the power which conveys it to the extreme veſſels, makes it penetrate every pore and filament of our frame, and from theſe ſubtile transfuſions recollects it, and returns again, what does return of it, to the heart. This I ſhall endeavour to do by a demonſtration of the following propoſitions; 1. The heart is not the fountain or origin of the motion of the animal fluids. 2. The blood in paſſing through the heart, and being ſubjected to its impreſſions, acquires no quantity of motion that it was not poſſeſſed of before. 3. That the arterial motion of the fluids does not depend neceſſarily on the impulſes of the heart, but can be accompliſhed independent of any ſuch force. 4. The mechanical force or momentum of the heart's contractions is abſolutely inſufficient to propel the blood to the extent of the arterial circulations and ſecretions. 5. There are, in fact, other powerful agents always ſubſiſting in the animal frame, which, by a mechanical neceſſity, muſt act in promoting the progreſſive motion of the blood, more immediately than the heart can do, and where the powers of the heart cannot reach. 6. There are, beſides all theſe, influences preſiding in the animal ſyſtem which can be reduced to no mechanical ſtandard, but, at the ſame time, without which all the intricate mechaniſm in our frame, juſt and unerring as it is, would not be ſufficient to ſupport one revolution, nay, nor one moment's progreſſion of our fluids. To theſe, by way of corollary, I ſhall add, 7. That both the primal and final intention of the agency of the heart in the animal œconomy, muſt be ſome further purpoſe, very different from, and leſs obvious than, the ſupporting of the progreſſive motion of the blood.

FIRST PROPOSITION.

FIRST then, I ſay, that the heart is neither the original ſeat of the motion of the animal fluids, nor the original cauſe of their motion. It is ſelf-evident, I apprehend, that we muſt look for the primary cauſe and powers of the motion of our fluids in the organs, which are conſtantly employed in taking in that ſtock of freſh ſupplies, which the repairs of our conſtitution, and the ſupport of its motions require; and here we are neceſſarily referred to the abſorption of the chyle, or of our digeſted aliment. The pulſations of the heart, or the momentum of its contractions, cannot reach the chyle in the firſt paſſages, and force it into the lacteal veſſels: theſe veſſels, as abſorbents, having not the leaſt communication with arteries, can partake of no aſſiſtance from them, in taking up the chyle, and tranſmitting it to the blood. Now the lacteals are a venous ſyſtem of veſſels, and the chyle's motion in them is entirely venous; that is, it is a concurrent motion, where the veſſels and the ſtreams that flow in them, are always uniting and enlarging *. How much it is the characteriſtic of all venous

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* Some may imagine, that the diſcharge of the chyle by the lacteal duct into the left ſubclavian vein, is of ſmall conſequence in eſtimating the powers which move the fluids; but this is a great miſtake: for, as in a ſound habit the repairs of nouriſhment muſt be equal to the waſte, ſo the power with which theſe repairs are introduced into the blood muſt be equal to the circulating powers concerned in the diſcharges of perſpiration, urine, and the animalire parts of the feces taken conjunctly.

ſyſtems of veſſels to act as abſorbents, we ſhall proceed to conſider.

2. In the lymphatics. The diſcovery of the ſource of the lymphatic ſtreams, has been of late thought a matter of ſo much conſequence in phyſiology, as to have been very keenly diſputed between two eminent anatomiſts: ſo that we may venture to take it upon the evidence of their experiments, that the lymphatics are alſo a ſyſtem of abſorbent veſſels gathering up extravaſated fluids, wandering out of the reach of the heart and arteries, among the interſtices of the veſſels. Theſe then, namely, the lacteals and lymphatics, are two ſtreams in the animal ſyſtem, that are not only perpetually flowing, but alſo perpetually ſupporting the motion of the other vaſcular fluids, independent of the direct impreſſions of the heart.

3. The abſorption of the lymphatics appears to me ſo inconſiderable, when

compared with that of the proper veins every where in our ſyſtem, that, if the lymphatics are not deſtined for a particular ſpecies of abſorption, which I am inclined to ſuppoſe, I can conſider them as no more than proviſional auxiliaries to the veins in that office.

4. THE nature of the connexion and of the communication of fluids between the unborn infant and the mother, demonſtrates that the ſupply of a venous circulation by ſuction or abſorption, ſeems to be univerſally Nature's direct method of communicating vital ſupplies, and of ſupporting the internal motion of the fluids of all organical beings, whether vegetable or animal.

WHEN we maturely conſider the immenſe power of abſorption in the ſkin, and not of it only, but of every ſurface within the body, one would be tempted to infer, that the veins almoſt wholly terminated in abſorbents.

But there is ſtill greater reaſon for the preſumption, if we reflect alſo that a very large proportion of the animal fluids are always in an extravaſated ſtate. If we conſider that the immenſely largeſt proportion of the vaſcular ſyſtem is of that attenuated kind, which the fineſt injections cannot reach; and at the ſame time, if we attend that the exterior ſurfaces of all theſe veſſels are conſtantly in as moiſt and ſucculent a ſtate as their cavities, we will ſee ſtrong reaſons to ſuſpect, that, though ſome of the arteries may paſs into continuous veins, yet the greater part muſt be terminated in imbibing orifices, and conſequently that the circulation muſt, in ſtrict propriety, be carried on by the medium of extravaſation and reabſorption, incomparably more than by any uniform continuation of arteries into veins.

It is not my intention in this diſcourſe to enter minutely into an inveſtigation of the phyſical cauſe of abſorption; but in ſo far as it appears of ſuch importance in maintaining the circulation of the blood, I muſt beſtow a reflection or two upon it.

First, then, it is generally, for explication, referred to that power by which fluids are ſaid to aſcend in capillary tubes. That the power exerted in every kind of attraction or ſuction may be the ſame with that which cauſes liquors to riſe in capillary tubes, I make no doubt; but ſtill, as the two motions are very diſſimilar in leading circumſtances, the aſcent of liquors in capillary tubes, as illuſtrated by common experiments, is a very unſatisfactory illuſtration of venous ſuction: for, in the firſt caſe, the tubes muſt be in an empty ſtate when fluids are exhibited to riſe into them.—Again, fluids do not continue to riſe in capillary tubes, but become ſtagnant at certain heights.

In venous abſorption, on the contrary, the fluids continue aſcending and penetrating into veſſels that are full, and likewiſe, they continue advancing progreſſively, without ſtagnating or becoming arreſted in their motion, at any height or diſtance from the priſion of the imbibing veſſels.

Hence, ſecondly, we muſt infer, that though all the veſſels in the animal compoſition are full from one end to the other, yet there muſt be a waſte or vacuum conſtantly going on at one extremity of the veſſels, in order to give place and make room for what is imbibed by their oppoſite extremities.—Liquors muſt ceaſe to riſe in any veſſel or veſſels which are full without waſte.—Therefore upon this ſubject it muſt, I think, be concluded, that the conſtant waſte and inanitions happening in the animal frame are the direct, though in another ſenſe, the remote cauſe of its capacity for conſtantly aſſuming freſh ſupplies into the veſſels.

WHAT theſe powers are, which diſſipate the materials of our conſtitution, I ſhall have occaſion to conſider more particularly by and by; but whatever they are, we muſt view that power of attraction which brings the chyle into vaſcular motion, in an inſeparable connection with them.

BY ſurveying the actions of our frame in this point of view, you muſt perceive, Gentlemen, that the venous and arterial circulations become indiſpenſiby tied together, and united in their reciprocal influence upon each other's motions, ſo as the one muſt always neceſſarily imply the other.

I MAKE this obſervation here, becauſe it may be objected, that though a venous or confluent circulation may not require the impreſſions of the heart to perpetuate it, yet an arterial or dividing circulation neceſſarily does—But I ſay, that if an arterial circulation can be conſidered as neceſſarily inſtrumental in the production of a venous circulation, which has no dependence on the impulſes of the heart; then the power of the heart, which in our conſtitutions lies between theſe two extremes, cannot be ſuppoſed eſſentially neceſſary to an arterial circulation, whoſe influence reaches to a circulation where the heart, as a muſcle, is not at all concerned.

HENCE it is inferred *a priori*, that of whatever importance the modification of the circulation at the heart may be in the conſtruction of animals, yet the heart cannot be ſaid to be eſſentially and abſolutely neceſſary to the circulation of our fluids.

SECOND PROPOSITION.

THE ſecond propoſition I have undertaken to demonſtrate is, that the blood, in being ſubjected to the contractions of the ventricles of the heart, acquires no quantity of motion that it was not poſſeſſed of before in the veins.

THE heart does not act upon the blood as a pump does upon ſtagnant water, putting it into a motion and courſe which it had not before.—This ſimile is not a correct one; for in fact the principal, though leaſt obſerved action of the heart, is its power as an exhauſter, which I ſhall alſo conſider: what at preſent I allude to, is its poſitive force in throwing the blood into the arteries.—In this reſpect, I ſay, it is not like a pump acting on ſtanding water.

IN fact, the blood was poſſeſſed of as much motion in the veins when it arrived at the heart, as the heart communicates to it in diſcharging it into the arteries. So that the interpoſition of the heart's agency in giving motion to the blood, cannot be ſuppoſed abſolutely neceſſary to its progreſs in the arteries, unleſs it could be proved that the momentum, with which the blood is diſcharged from the vena cava, was inſufficient to preſerve its courſe in the arteries, without the additional aſſiſtance of the heart's contractions.---But it is abſurd to ſuppoſe this, if it can be proved, that the momentum of the blood in the vena cava is as great as the momentum of the blood thrown into the aorta by the heart.

THE heart tranſmits, by its contractions, no blood into the arteries but what it receives from the veins *; therefore

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* It is true, that the excretions muſt be deducted from the quantity that the veins receive from the arteries, but that is compenſated for by the ſupplies the veins receive from the chyle.

it cannot deliver it either faſter or with greater momentum than it receives it.—Therefore, alſo, the momentum of the blood in the veins is equally ſufficient, as the contractions of the ventricles of the heart, to ſupport the motion of the blood in the arteries.

NAY more, I ſay, that the abſolute momentum of the blood moving in the vena cava, and conſequently in all the veins, is greater than the momentum with which it moves in the aorta, and conſequently in all the arteries:—For though the heart can deliver no blood to the arteries, but what it receives from the veins, yet the veins really receive as much reſiſtance to the freedom of the motion of the blood in them, by every contraction of the auricles of the heart, as the arterial blood receives acceſſion of momentum by the contractions of the ventricles; excepting in ſo far as the muſcular vigour of the auricles and ventricles may differ from each other.

I KNOW that appearances may be pleaded againſt me, and that it may be alleged that an artery of the ſame dimenſions bleeds with much greater violence than a vein does. But in the firſt place, it may be replied, that there is no making a comparative eſtimate between arteries and veins in this reſpect, on account of the different thickneſs of their coats—on account of the uncertainty of the contiguous anaſtomoſes—and likewiſe on account of the different ſtate of the elaſtic vapour of the blood in arteries and in veins.

AGAIN, all circumſtances ſuppoſed equal, and allowing the fact to be true, the velocity with which a fluid flows out of an orifice is no proof of its degree of velocity in its veſſels, but is rather a proof of its progreſſive motion not being proportioned in velocity to the power with which it is urged. There is a great difference between being preſſed with greater force, eſpecially alternately in the percuſſive manner, and moving progreſſively with greater momentum. The firſt I allow in the caſe of the arterial blood; but the laſt, I deny: at leaſt I am not acquainted with any proof of the contrary.

THIRD PROPOSITION.

Having proved under the laſt propoſition, that the motions of the heart add nothing to the momentum of the circulation—that the force of the blood iſſuing out of the veins is as ſufficient as the force of the heart to ſupport an arterial circulation—and that the venous and arterial circulations are connected together, in the relation of cauſe and effect, by links that are independent on the power of the heart's ſyſtoles; I come now to prove the truth of the ſame doctrine by examples, that arterial motions of fluids can be ſupported, and are in fact, conſtantly celebrated without the neceſſity of the heart's actions, or the interpoſition of ſuch a forcer in the center between a venous and an arterial circulation.

Because in the particular diſpoſition of our frame, the heart is known to occupy this ſtation, and to preſide at the orifices of the great arteries, therefore, by I know not what diverſion of our attention, or deception from appearances, it has always been taken for granted, that there was a mechanical neceſſity for the action of the heart there, and that without it, the momentum of the blood in the vena cava could not have been ſufficient to have diſtributed and divided it in the arteries, through ſuch an infinite number of ramifications, and in ſuch an inconceivable variety of directions, produced by the angles, flexures, and involutions of the veſſels, as they divide and decreaſe.

THOUGH perhaps all motion, ſtrictly ſpeaking, is both impreſſed and continued by preſſure*; yet there are certain motions, ſuch as the running of water, the aſcent of vapour and the like, that having no ſenſible appearance of any reſiſtance to their tendency, may in an improper and vulgar ſenſe be termed ſpontaneous; and ſuch I take the motion of the fluids both in the veins and in the arteries to be.

THE firſt example I ſhall adduce of this kind of arterial motion, which is ſupported without any ſuch impulſes as are analagous to the ſhocks of the heart upon the blood, is the circulation or progreſſive motion of the ſap in vegetables.

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[*] Though attraction is a term that may be alledged not to define the nature of the power it expreſſes, but only to denominate the fact, yet as the ſignification of the word certainly conveys an idea very different from any kind of mechanical impulſe, it is to be wiſhed a word for that phœnomenon had been adopted which would have given no bias to the ideas of enquirers.

tables. In them, the fluids aſcend of their own accord, as we expreſs it, to the remoteſt branches, leaves, and fruit of the loftieſt trees *.

It implies no objection to my argument to allege, that in plants the caſe is not parallel, as in their transfuſion of fluids there is no direct or regular tranſition of arteries into veins. But what then ? ſtill the example is concluſive for what it is adduced to prove ; namely, that in their ſyſtem of circulation, the veins or roots of the plant act by abſorption only ; and, without the aſſiſtance of any vegetable mechaniſm analogous to the functions of the heart, transfuſe their juices to the fineſt and remoteſt fibres of

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* It is certain, that in the vegetation of ſome trees, fluids riſe higher than either what we know of the ſuction of capillary tubes, or of the preſſure of the atmoſphere on fluids in vacuo, will carry them ; therefore, it is a queſtion, whether there may not be ſtill reſources for mechanics to raiſe fluids higher than it is at preſent ſuppoſed fluids can be elevated by artifice.

of the plant, which are its ſyſtem of arteries.

AGAIN, to come directly to the point, we have in the particular œconomy of the liver a proof of that very ſpecies of circulation in our ſyſtem, without the intervention of any pulſatory action, which has been ſuppoſed neceſſary to give venous blood an arterial direction and momentum.

THOUGH the liver is the moſt maſſy and compactly-formed viſcus in the whole animal compoſition, yet the venous blood gathered from all the internal parts of the lower abdomen, entering it, immediately changes its confluent courſe.—The end of the vein entering a particular part of the liver, (called by anatomiſts, the portæ or gates) reſolves itſelf into an artery, divides into branches, and ſpreads its ramifications through the whole ſubſtance of the liver, where, after furniſhing the ſecretion of the bile,

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the blood has a ſecond time its courſe reverſed into a venous one, re-collecting it from the extremities of this ſingular artery, and bringing it back to the general conflux of the blood in the vena cava before it reaches the heart.

In this inſtitution of animal circulation in the liver, the heart can have no immediate concern more than the kidnies, or any other particular organ in the conſtitution. Therefore we juſtly conclude that the heart occupies its ſtation not as a *ſine qua non*, or indiſpenſible organ in the circulating of animal fluids.

Nay more; in the regulation of the circulation in the fœtus, or in unborn infants, the Author of Nature has ſhewed us, that at the heart itſelf, Nature, the miniſter of his power, can manage the circulation even there in a great meaſure, without the heart's aſſiſtance.

For, leaſt the lungs of infants, upon their firſt coming into the world, ſhould be either ſo over-grown, or ſo overcharged with blood as to reſiſt the impreſſions of the firſt breath of life ruſhing into them by inſpiration, the better half of the blood diſcharged in born perſons into the heart by the vena cava, is in unborn infants conveyed by a canal provided for the purpoſe, ſtraight into the aorta or great artery, without being ſubjected to the impreſſions of the heart at all. So that this moiety proceeds in its courſe along the aorta, *&c.* without the aſſiſtance of the heart's action.—Nor can it be ſuppoſed that this moiety of blood owes its after progreſs in its arterial courſe, to the ſtrokes of the heart on the other moiety that paſſes through the lungs; the heart's power being only ſufficient for the quantity it acts upon.

FOURTH PROPOSITION.

The fourth propoſition which I ſhall endeavour to prove, is, that the muſcular power of the heart is not of force ſufficient to impreſs that momentum upon the fluids that muſt be required to carry them to the ultimate limits of the circulation.—I never addicted myſelf much to theſe branches of phyſiology, which depend upon nice algebraical calculations, therefore I will reſt my concluſions here upon ſuch general principles as will ſufficiently anſwer my purpoſe. —For the argument's ſake then, I ſhall in the firſt place, admit that the muſcular force of the heart is as great as any perſon upon calculation has ſuppoſed it to amount to.———

If the progreſs of the circulation in the arteries depended upon the mechanical force with which the heart threw the blood into them, may it not be aſked, What then is the reaſon that no ſyringe can be invented that can be made to drive the ſubtileſt and moſt ſearching liquor half ſo far, or into one tenth of the number (I take a definite for an indefinite here) of the veſſels that the heart reaches and fills by its injections?—If it is replied, that this is owing to the different circumſtances that both ſolids and fluids are in, while ſubjected to the impreſſions of the heart's power, from theſe the dead ſubject is under, when artificially injected; I grant that it not only may be ſo, but that it certainly is ſo:—But then, it alſo certainly follows, that theſe circumſtances, and not the heart's force only, are the cauſe of the ſucceſs of its injections reaching the fineſt and remoteſt filaments and excretories in the animal ſyſtem.

There are powers in Nature, which can inſinuate and drive moiſture, both into veſſels and into the interſtices of bodies, ſo as to overcome an inconceivable reſiſtance to its progreſs.—By ſuch means, the hardeſt twiſted ropes may be ſhortened with ſuch power as to move immenſe weights faſtened to them;—and the roots of trees have been known to open fiſſures in very maſſy rocks which reſiſted their growth and diſtenſion.——But in ſuch caſes, any power driving ſuch fluids, analogous to the contractions of the heart in the animal ſyſtem, would prove of as little effect almoſt in the promoting of ſuch motion, as the fannings of a fly's wings would.—The caſe is nearly ſimilar in regard to an infinite number of the compact filaments and ſtrainers through which the animal fluids have to make their way.

AGAIN, if we conſider the nature of the fluid, I mean the blood, ſuppoſed to be ſo ſyringed by muſcular force, through ſuch a complicated ſeries of meanders and involutions in the ſlendereſt and almoſt inviſible veſſels, we ſhall find it the unfitteſt liquor that can be imagined to be driven in its courſe by main force:—for it muſt be a force not only ſufficient to urge a permeable liquor (which yet is impoſſible) but it muſt be a force ſufficient to grind down the viſcid, glutinous tenacity of the blood, and break down the unequal ſizes of the particles of its conſtituent parts.—That all this can be done by the main force of the contractions of the heart is ſo impoſſible, and ſo palpably ſo, that it never could have been thought of, but through the greateſt inattention.

If it is alleged, that the momentum of the heart is not ſuppoſed to be concerned in attenuating the blood, and changing it into the ſubtilty requiſite for paſſing the fineſt canals and emunctories in its courſe,—I ſhall accept of the conceſſion, without making any ſtrict enquiry, whether many phyſiologiſts by their mode of reaſoning and explaining themſelves, have given ſufficient cauſe for the imputation or not.—But if it is allowed, that it is not the momentum given to the blood by the heart that reſolves it in the courſe of the circulation; then it follows, that there muſt be ſome other active power in our frame, which can change the ſtructure and tenacity of our fluids at will. This implies, that that power which changes the blood, when the force of the heart cannot do it, muſt alſo be the power which moves the fluids, where they are ſo changed by it.—For where they muſt be changed, there they muſt have ſtuck if they had not been changed.

In ſhort, every conſideration conſpires to evince, that the power of moving the fluids, where they are changed or aſſimilated to the nature of the parts they arrive at, and the power that aſſimilates them, muſt be one and the ſame; —and what moves by that principle, muſt move ſpontaneouſly, that is, without any occaſion for the application or aſſiſtance of that power we apply the idea of downright mechanical force to.

THERE does not appear to be in our conſtitution any of theſe ſtrainings and filtrations, that have often been ſuppoſed in phyſiology. Our fluids are digeſted in ſuch a wonderful manner, and at the ſame time, the various organs are ſo wonderfully adapted to them, that whenever they arrive within the influence of each other, the fluids inſtantaneouſly reſolve, or are metamorphoſed, and diſpoſed into a motion conformed to the ſtructure of the organ.—They move, to uſe the ſimile, as iron does when it is ſaid to be attracted by the loadſtone.

I BEG leave to touch upon another conſideration relative to this propoſition, before I diſmiſs it. It is another miſtake of inattention, and not a ſmall one in my opinion, which phyſiological calculators have ſtumbled upon in their computations. They have always ſuppoſed that the heart contracts with the utmoſt muſcular force it is capable of exerting; than which, in my opinion, there cannot be a greater miſtake.

No muſcle can be either always, or the half of always in the exertion of its utmoſt muſcular vigour and power.—This, in a very ſhort time, would overſet the whole equilibrium of our ſyſtem. The ſtrength of a man's muſcles may be able, by way of eſſay, to lift and ſupport for ſome time, by their utmoſt tenſion, an hundred, or we ſhall ſuppoſe two hundred weight. But if all his life was beſtowed in ſuch an exertion, it would become a very ſhort one.—Reaction will always be equal to action; and this law infallibly holds true in our ſyſtem, as well as in all other caſes. Every violent action has a violent effect, which muſt affect the whole conſtitution.—The energy of the ſmalleſt muſcle exerted every moment, or every other moment, would throw all our other animal functions out of that poiſe which is eſſential to life.—A muſcle acting perpetually or momentarily at the utmoſt ſtretch of its force, would become to the conſtitution like the power of the ſpring or weight in a piece of clock work, without a regulator or pendulum.

I AM not ignorant that muſcles without antagoniſts are ſaid to be always in a ſtate of contraction, without any of that hazard I apprehend. But no natural involuntary contraction is ever violent or extreme.—The contractions of ſuch muſcles are a ſtate of eaſe and not of force; it is a gentle play, and not a violent labour; and ſuch muſt the action of the heart be—Therefore the blood cannot require theſe violent efforts to force it into its courſe. It muſt go almoſt ſpontaneouſly, as a ball thrown gently down hill, or that is humoured, ſo to phraſe it, in its tendency.

In fact, I think there is much reaſon to preſume, that almoſt all the quantity of motion the blood actually receives from the heart, is exhauſted in the extenſion of the vibrating arteries—The reſt of its progreſſive motion we ſhall, as we have hitherto done, call ſpontaneous, until we can diſcover what other powers exiſting in the ſyſtem, preſide over and regulate its courſe; which brings me to the

FIFTH PROPOSITION,

Which I propoſe to confirm; that, namely, there are other powerful agents always acting in the animal frame, which by a mechanical neceſſity influence the progreſſive motion of the blood, as well where the powers of the heart can be traced, as where they cannot poſſibly reach. All arterial circulation terminates either in evacuation—transfuſion—or accretion.

As accretion cannot be ſuppoſed to be performed by the action of the heart upon the fluids, but by that power which diſpoſes ſimilar ſubſtances to coaleſce, whenever the quantity of that tendency is greater between them than the tendency of ſuch particles to ſeparate motion; there is no occaſion for being more particular on this article.—We ſhall therefore proceed to conſider evacuation,——Transfuſion depending upon it.

The evacuations of the circulating fluids, then, are performed either without the body, that is from the ſurface of the body, to which the common air has acceſs; or—within the ſurface of the body. The laſt, namely, the evacuations within the ſurface of the body, are —either drained off by glandular ſecretion, or—by accidental eſcape of humidity into all the interſtices and exterior ſurfaces of every veſſel and fibre.

These then I would have you to conſider, Gentlemen, as the leading circumſtances, which not only give direction to the motion of the fluids, but which actively ſollicit them in their courſe, as I ſhall afterwards ſhew more particularly.

Let us next conſider what are theſe requiſites in the fluids themſelves, which diſpoſe them to what I ſhall be well enough underſtood in calling *ſelf-motion.*—The firſt requiſite then is, that a fluid be endowed with an evaporable degree of heat: Such a degree as diſpoſes it to preſs towards a colder place and ſtate, and to fly off in vapour where-ever it can eſcape or get vent. This quality the blood is poſſeſſed of in a very remarkable degree. It diſcovers more vapour or volatile effluvia in it, than any liquor of the ſame degree of tenacious viſcidity that we know would do, under an equal degree of heat.

THE *ſecond* requiſite is, ſuch a mixture and compoſition of principles in the fluid, as diſpoſes it to that peculiar kind of inteſtine motion, called *fermentation*, by which the liquor expands itſelf, runs into new combinations, and generates new principles.——Thus, by fermentation, ſpirituous liquors are generated out of ſaccharine ones, and acids are generated out of ſpirituous liquors, or ſuch as might become ſo: And out of animal liquors, allowed to run into the ſame kind of inteſtine motion, are generated fœtid and volatile ſpirits.—Now there is a double tendency of this fermentable kind always exiſting in the blood; the vegetable part of our chyle or concocted food is, by this inteſtine proceſs, always aſſimilating into the animal nature, and the animalized parts of our fluids are ſo diſpoſed to that fermentation which terminates in putrefaction, that nothing could preſerve them from it, but the directing of its niſus from that tendency, into a progreſſive motion.

THE *third* active principle in liquors diſpoſing them to ſelf-motion is, the tendency in all liquors diſpoſed to ferment, to generate and extricate very volatile elaſtic effluvia of particular kinds, now commonly, though perhaps improperly, called *fixed air:* and this, moſt probably, is one cauſe of the remarkable abundance of elaſtic vapour, which I obſerved already was ſo copious in the blood.

WHENEVER vents are opened to liquors ſtrongly diſpoſed to ſelf-motion, by any or all of the above circumſtances, thither its whole niſus muſt be intended. A familiar and ſtriking inſtance of this we have in liquors put into bottles, and corked before their fermentation is finiſhed. We all know with what violence they will not only diſcharge the corks out of the bottles, but throw themſelves out of them in *jet d'eaus.*

It is one of the manifold ſtrokes of infinite penetration and ſagacity, diſcovered in the regulation of our fabric, that the innate diſpoſition in our fluids, ariſing from their commixture, to degenerate from their animal ſtate, ſhould continue ſo long to be exactly ſo far, and no further exerted, than to determine them by its niſus into progreſſive motion; and that, at the ſame time, this very progreſſive motion ſhould prove that very critical check which reſtrains the niſus to putrefaction in animal fluids, from advancing any further towards a pernicious change.

The firſt ſeries of paſſages, abovementioned, prepared for the progreſſive courſe of the blood diſpoſed for motion, as juſt now deſcribed, are the pores of the ſkin; which are of three kinds:—— The terminations of arteries—the excretories

tories of theſe glands immediately under the ſkin, commonly called the ſebaceous glands—and the accidental, we may call them, vents, through the intertexture and agglutination of the veſſels of the ſkin, which give paſſage to ſuch portions of the extravaſated effluvia as approach theſe orifices.

ALL liquors which, from their attenuation, warmth, and divided ſtate, are evaporable, have a tendency to fly off into a cooler and leſs confined region, and to recede from that degree of warmth which volatiliſes them, whenever they can. This courſe they take wherever the air has acceſs to them, as on the ſurface of the body, the lungs, &c. —Upon the ſame principle, the particles next in ſucceſſion to theſe that have eſcaped, take their place, and thoſe immediately behind them again occupy theirs: And ſo the ſame principle has its influence backward to the very riſe and ſource, not of the arterial circulation only, but to the remoteſt venous abſorption alſo.

THIS, I apprehend, is nearly what is performed in vegetable circulation; and this power, in common with vegetables, we have conſtantly exerting itſelf in promoting our circulation.—But though we have this power in a degree as much more active in us as our fluids are warmer and more evaporable than theirs, yet it is far from what is ſufficient to accompliſh all the intricacies in the motions and ſecretions of the animal fluids.

THOUGH it may be queſtioned whether there is in the compaſs of nature ſuch a thing as a ſtrict and proper vacuum, yet we certainly find everywhere ſuch improper vacua as anſwer all the purpoſes of abſolute ones, by not only giving free acceſs to the motion of groſſer and more conſiſtent bodies in them, but by really giving the motion of all ſuch bodies a direction and tendency towards them.—Whatever is the mechanical cauſe of this, I have no occaſion to enquire into it juſt now: It is ſufficient for my purpoſe at preſent, that this matter may be depended on as a fact.—Where-ever then there is the ſecretory or excretory duct of a gland, there, or in the courſe of the liquor ſecreted from that gland, there is to be found ſuch a vacuum as neceſſarily influences the courſe of the humours arriving at it: it does ſo as neceſſarily, as a cupping glaſs either ſwells the part, or draws the blood into it, where it is applied.

LET us illuſtrate this by an example where this influence is moſt obvious. In each of the kidnies there is a cavity, called the pelvis, into which all the ſecretory veſſels of theſe glands open: Of courſe, when that cavity is empty, thither will the liquor in the ſecreting veſſels flow, and thither will all the liquors in the veſſels communicating with the ſecretories ſtrain their motion and tend.—If theſe cavities, called the pelves, had no vent from them, whenever they were full, the tendency of more liquor into them would be at an end, and the circulation in the kidney would ſtop of courſe; except in ſo far as the regurgitation might be relieved by abſorbent veins.—But there is a long canal opens into the pelvis of each kidney, and runs from that down into the bladder. By emptying the bladder, there is a comparative vacuum made, equivalent to the ſize and quantity of the urine it contained before it was emptied.—I call it a comparative vacuum, becauſe the room of the full bladder, when emptied, is occupied only by the elaſtic effluvia contained in the inteſtines preſſing the lower abdominal parts into the vacuum made by the diſcharge of the urine. So of courſe, the bladder becomes as neceſſary and effectual a drain from the pelves, or cavities of the kidnies, as theſe are to the kidnies themſelves.

The caſe is preciſely the ſame, though perhaps not ſo obviouſly ſo, with regard to every gland in the body—each has its ſecretory either more immediately or more remotely ſucked by the influence of ſome one comparative vacuum or another.—I ſay, ſucked, not becauſe of the phyſical propriety of the term, but becauſe it emphatically expreſſes the agency that I would have you conceive theſe vacua have upon the fluids contained in veſſels that they correſpond with.

By what means of the ſame kind there is carried on a conſtant extravaſation of effluvia, which bedews and keeps plump and ſucculent all the parts of the body, exterior to the veſſels and fibres every-where, will be beſt underſtood by explaining the important vacua, by which the venous flux of the blood is immediately affected and preſerved.

Ever ſince the aſcertaining of the circulation of the blood, that is, for above theſe hundred years paſt, phyſicians have treated the momentum of the heart's contractions throwing the blood into the arteries, as a ſubject of the greateſt attention and importance both in phyſiology and in the practice of medicine.—But none, that I know of, has beſtowed that attention which is due to the eſſential part the heart acts in the promoting of the venous circulation, not by its impulſes, but by its depletions: yet nothing can be more abſurd than to ſuppoſe the one, or more inattentive than to neglect the other.—The ſole ſupport and preſervation of a venous current of blood to the heart, depends upon a vacuum being momentarily provided where the veins ſhall unload themſelves, I HAVE ſhewn already, in the mode of circulation inſtituted at the liver, that the impelling pulſations of the heart are not of eſſential neceſſity either to its arterial or its venous circulation. But in the mode of circulation eſtabliſhed at the heart, its evacuations, or its alternate ſtates of emptineſs become indiſpenſably neceſſary to the whole ſyſtem of the venous circulation. Let us only examine this point with ſome attention more circumſtantially.

WHEN the veins are all full, and the auricles, or chambers into which the veins empty themſelves, are full alſo— Where is the collected ſtream in the veins to go next? There is no room for more in the auricle: What muſt be done?— Why, the auricle contracts and empties itſelf. What is the conſequence? Why, a ſudden vacuum, equal to what the auricle could contain—the turgid veins ruſh their contents into the auricle to fill up the vacuum again, and all behind moving in the venous direction advances ſo much forward, with ſuch force, that the veins near the heart ſuſtain a pulſation from the regurgitation of this impetuous ſtream, when the auricle ſhuts upon it to empty itſelf.—In ſhort, the full auricle occupies a determinate quantity of room in the breaſt: When it is emptied, there is a non-reſiſting vacuum of ſo much ſpace as was full before, and thither there is a mechanical niſus from the remoteſt filament of a vein over the whole body, which becomes conſpicuous in the torrent that ruſhes every other moment from the mouth of the vena cava into this vacuum.

Thus not only the continuous veins, ſuch as there may be, but every humid interſtice and all the extravaſated effluvia within the ſurface of the body, is ſucked, attracted, or impelled, call it what you pleaſe, as it offers into the direction of the venous ſtreams.—All this is ſo mechanically neceſſary and ſo conſequential, that I cannot help repeating my ſurprize that it has ſo long remained unaſcertained. But here I muſt not omit doing juſtice to the great Haller, who ſeems to have conceived ſome idea of the influence of vacuums on the circulation, when, ſome where in his phyſiology, he ſpecifies a *vis derivationis quæ ſanguinem a ſede majis compreſſa ad ſedem laxiorem et minus reſiſtentem ducit.* Which power of derivation, he ſays, is not ſufficiently known yet; and which I have here endeavoured to aſcertain and explain.

SIXTH PROPOSITION.

Notwithſtanding all the completeneſs of mechanical proviſions that we find eſtabliſhed for ſecuring the circulation, yet they can be conſidered as no more than auxiliaries or acceſſories, ſeeing the motions of the animal ſyſtem could not be kept in play one moment by them all, without the preſidency and uninterrupted influence of a power, which I will not ſay is unmechanical, but which we cannot reduce either to diſtinct mechanical rules or ideas. I mean that active principle exiſting every where in the ſyſtem of animals, which I call *life.* —I do not mean that immaterial immortal part in us, whoſe concerns are more elevated and permanent than the regulation and ſupport of a temporary material automaton.—I mean that ſupreme principle of natural life, which exiſts in every point of our frame, and diſſeminates its univerſal vitality in the irradiations of ſenſations, affections, volitions, &c. of every kind.

THE ſtructure of our brain and its nerves, obliges us to conſider this eſſential principle, at the ſame time that it is exiſtent and in conſtant activity every where, as a real glandular ſecretion. Therefore, in its private office, the conſtant flux of this vital principle from the head to every point of our frame, muſt be conſidered as eſſential to the perpetuating of the circulation in the head, as the ſecretions of other glands are to the maintenance of the circulation in them.

Yet what is truly wonderful of this ſecretion, and may with propriety be propoſed as a paradox, or phænomenon of the moſt difficult ſolution, is that it is a ſecretion without a waſte, or without any conſumption of the ſtock from which it is drawn *.—This renders the mode of the circulation in the brain different

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* Thus it is that electrics *per ſe* are ſuppoſed to draw their electrical fire from non-electrical bodies, and to iſſue it always longitudinally into whatever direction the conductor is bent or twiſted; tho', if ſollicited by the approach of any non-electric, it is ready to burſt out ſide-ways at any part of the length of the conductor. This obviates another difficulty in regard to the motion of the vital principle along the nerves. If it is ſo ſubtile as to penetrate their ſubſtance in all directions, how can it hold its courſe according to their lengths, and diſcharge its influence regularly where they terminate?

ferent in its circumſtances from all other parts of the body, the heart, the liver, or any where elſe; becauſe, as I apprehend, the blood which goes into the brain by the arteries is all returned undiminiſhed back again by the veins: So that we cannot have at leaſt that direct recourſe to the influence of a vacuum there, that we have in ſolving the phœnomena of the circulation in other glands. But at the ſame time that perpetual efflux conſtantly ſtreaming off from the nerves, and animating every particle and fibre by its energy, muſt have a powerful influence on the circulation of the animal fluids, through the ſubſtance of the brain, both as a director and as a motive power—This I call the private office of this ſecretion.

THAT the nerves alſo ſhed their influence univerſally and intimately to every part and receſs of our ſubſtance, is, I think, what no one doubts; though few have reflected that it muſt, by a neceſſary conſequence, produce active vital effects, both upon the motions and diſpoſitions of the fluids in every part—I ſhall attempt to aſcertain this fact by an argument, which, if it ſhould be thought new, will not, I hope, be rejected merely on that account, if, upon weighing, it proves concluſive.

NOTHING can be more certain and undoubted, than that the ſenſes, paſſions, and volitions have not only a moſt powerful, but in many inſtances a moſt inſtantaneous and moſt ſenſible effect upon the motions of our fluids ; in ſome caſes, throwing immediate colour and heat into particular parts of the body, and in others, throwing the whole frame into a colourleſs rigour, and ſpreading a languor over all the motions of the fluids :—in ſome inſtances, filling the whole machinery with an inſtantaneous lightneſs and vivacity in all its motion ; in others, as ſuddenly oppreſſing

preſſing and in a great degree choaking all the vital powers.

Now, can it be ſuppoſed that this vital principle, diſtinct from all that we know of the mechanical compoſition of our frame, adjuſted for maintaining the complicated motions of our fluids, could effect its motions ſo inſtantaneouſly, if it was not always preſent, and indiſpenſably acceſſary to them at all times?—In ſhort, it proves, that that very principle, which is conſtantly blazing in us in living ſenſations and paſſions, is as inceſſantly employed in promoting and regulating every living movement of our fluids in every part.—It could not act as it does in ſuch inſtances as I have hinted at, unleſs it was conſtantly acting.

It has always appeared very ſtrange to me, that many have been ſo curious in eſtimating all the mechanical circumſtances they could conjecture to themſelves, that might conſpire in the circulation,

lation, and in calculating their powers; as if any ſatisfactory ſum total of the moving powers could be aſcertained upon ſuch principles.—In what we call mechanical, mechanics do all; but in a living machine, they do nothing.—It is life immediately and directly that does all; and mechaniſm is no more than a ſubordinate arrangement, ſeconding its operation, and a channel for life to move in.—What in phyſics are called the powers or laws of nature, are not more fundamentally eſſential to mechanics, than what I call *life* is to them in the animal ſyſtem.—In the human frame, life occupies the known properties and tendencies of matter by means of mechanics; but no mechanics can be conceived by the human capacity which can perform what the living principle does.—Yet phyſiologiſts often reaſon and diſcuſs their ſubject, as if life was the effect of mechanics, inſtead of conſidering them as only the track in which life moves, and the foot-ſtool of its powers.

The exertion and powers of the nervous ſyſtem, acting uninterruptedly, and diffuſing their virtue conſtantly in the ſame directions with theſe in which the animal fluids move, muſt efficaciouſly promote their progreſs.—Beſides that animated vital character which the effluxes of that ſyſtem ſuperadd to the warmth and chymical commixture of the animal principles, in every ſolid and in every fluid particle of our frame, it inſtantly inverts, changes the arrangement, and diſpoſes the habit of each moving particle, ſo as to become entirely metamorphoſed, and inveſted with the particular character of that very part where it either flows, is ſecreted, or accreſſes.

If we advert that life is but another name for ſelf-activity, and conſequently that the very eſſence of life lies in that activity, it is impoſſible but that the fluids in which that life reſides, as much as in the ſolids, muſt enjoy activity as a principle of their conſtitution, and not yield to motion by external mechanical impulſes only, like inert paſſive maſſes. So active is this principle in us, that we cannot call our ſenſations or perceptions themſelves more vivid than it is in every part.—Indeed our ſenſations themſelves are not any thing elſe than perceptible copies of the inſtantaneous activity of this principle reſiding in the ſolids and fluids which compoſe every organ of ſenſe, in receiving, and variouſly modulating itſelf to every impreſſion that the courſe of nature without us can poſſibly make upon theſe organs.

BUT to drop the abſtracted diſcuſſions that this branch of phyſiology ſuggeſts, and to be brief.—It is this principle of life, that gives that facility and momentum to the univerſal circulation of the animal fluids, which deſerves the name of ſpontaniety; without which, all the injectings and mechanical contrivances in nature could not open the receſſes of the vaſcular ſyſtem, and render them pervious to the moſt ſearching and penetrating fluids.—It is this inherent, or rather conſtantly influent principle, that renders all, both ſolids and fluids, ſo active, ſo vigorous, ſo conſiſtent; and at the ſame time ſo placid, ſo obedient, and ſo permeable, infinitely beyond the reach of merely mechanical impreſſions.—In ſhort, it is this, and not the diameters of veſſels, the angles at which they divide, their elongations, flexures, or involutions, that renders all ſo lubricious, ſo various; and yet upon every change and ſecretion, ſo characteriſtic, and ſo uniform.—This work is not performed by the ſtubborn, robuſt agency of grinding, or dividing, by ſeparations and percolations, ſtrainings and ſqueezings of refractory combinations and commixtures of heterogeneous fluids: But every moving active particle of the fluids is preſently, and without one protracting reniſus, tranſmuted into the nature and habit which the organ it arrives at, diſpoſes it to aſſume.—This living temper and warmth oſcillates in every ſolid fibre, and fans the fire of nature in every fluid particle that approaches them: While theſe again return the quickening vibration to every ſolid, and diffuſe it reciprocally among themſelves.

SEVENTH PROPOSITION.

FROM what I have, I hope, proved, it neceſſarily follows, that both the primary and the final intention of the pulſation of the heart in the animal œconomy, muſt tend to ſome purpoſes diſtinct from the neceſſary ſupport of the progreſſive motion of the fluids. I ſhall beſtow a few reflections on what ſome of theſe purpoſes may be.

FIRST, then, it muſt be attended to, that the alternate pulſations of the heart neceſſarily imply a correſpondent alternation of the effluxes, or powers of the nervous ſyſtem, and of their origin the brain; at leaſt in ſo far as their powers immediately reſpect the action of the heart.

PHYSIOLOGISTS generally ſuppoſe that the chambers, namely, the auricles and ventricles of the heart, are in a paralytic ſtate during the time of their diaſtoles, or during the time they are filling again with blood, after they have emptied themſelves by their ſyſtoles or contractions. It is alſo now ſuppoſed by ſome ingenious phyſiologiſts, that the heart is conſtantly rouſed out this paralytic ſtate by the irritation of the blood that fills theſe cavities from time to time. But this theory wholely reſts upon the ſuppoſition, that the relaxed ſtate of theſe muſcles is owing to ſome peculiarity in their ſtructure, by which they cannot preſerve their muſcular contraction above an inſtant at a time, and that they cannot recover it but by the reiterated action of a ſtimulus upon them.

Now all this is ſo contrary to every thing that we know of the nature and tendency of muſcular fibres in other caſes, that the ſuppoſition ought not to be admitted upon leſs than a demonſtration, that it cannot be explained upon other principles more agreeable to the animal œconomy. We have inſtances of the natural contractile power of muſcular fibres being relaxed by irritation, as happens to both the ſphyncters of the principal excretories in the body when they are ſollicited to a diſcharge: But I do not remember one inſtance of muſcular fibres whoſe natural contraction depends on irritation, not even the circular fibres of the iris.

No ſound muſcle can be in a relaxed paralytic ſtate, except from a defect of the influence of the nerves which communicate with it. Hence it follows, that the intermiſſions of muſcular action in the heart, muſt proceed from an intermiſſion in the action of the brain and nerves upon it. There muſt be eſtabliſhed intermiſſions there of the effluxes from theſe organs of life upon the heart, which determine its alternate ſtates of action and inaction.

THEREFORE before phyſiologiſts take upon them to determine the uſe of the contractions and relaxations of the heart, it becomes a neceſſary previous enquiry, to diſcover what may be the uſe of theſe intermiſſions in the vital organs where they originate; becauſe poſſibly the importance of theſe alterations there, may be greater than in the heart, where they appear more ſenſibly, though only as an effect. I cannot propoſe here to enter more minutely into this diſquiſition: I ſhall therefore diſmiſs it with this reflection.

Seeing reaction muſt always be equal to action; and as no effect can be greater than its cauſe, therefore the alternate efforts of the brain on the nerves that agitate the heart, muſt have as great an effect on the brain itſelf and its effluxes, as it has ſecondarily on the heart itſelf and the fluids whoſe courſe it regulates.

SECONDLY, there is good reaſon and ground to ſuppoſe, that the concuſſions of the heart have alſo a direct effect forward, upon the ſyſtem of the ſolids in which the fluids agitated by the heart move. I do not mean merely that paſſive expanſion and pulſation which it cauſes in the arteries, though I include it; but that every ſhock of the heart excites a reciprocal orgaſmus, or active tenſion, through the whole ſeries of the ſolids, which keeps them always prepared and enlivened for admitting and acting upon the fluids every where, in the manner I have attempted above to expreſs my conception of*. Whether the arterial and venous ſyſtems connected with the ventricles and auricles of the heart by tendinous-like beginnings, act as antagoniſts to the muſcular contraction, I ſhall ſubmit to the deciſion of further enquiry and obſervation.

THIRDLY, that the contractions of the heart alſo momentarily irritate and rouſe that vital principle animating every fluid particle, I have no doubt of. But in order to comprehend fully the influence of the heart's contractions upon the fluids immediately paſſing through it, the circumſtances and qualities of the blood brought by the veins to the heart muſt be conſidered.

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* There is ſome reaſon to queſtion whether the mere mechanical force with which the blood is thrown into the arteries, is the direct and only cauſe of the force, wherewith the arteries vibrate. I have ſeen an aneuriſm in the arm that would have moved more pounds of weight than the artery either above it or below it, if I gueſſed aright, could move ounces. How that momentum was generated there, I leave to the reflexions of attentive phyſiologiſts.

We are not, I have intimated already, to conſider any part of the vaſcular ſyſtem as a congeries of merely paſſive canals for the fluids. The importance of the veins, diſtinct from that of their being canals, has not been duly conſidered. Their office conſiſts of two parts.

First, that of thoroughly animalizing the recent chyle, which has undergone only an arterial courſe.—It is evident from the ſecretion of milk, that ſome of the fineſt filtrations of the arterial circulation remain ſtill aceſcent: But the veins complete the change, and render all the fluids in them perfectly animal, and of conſequence, they muſt exalt the animal nature of ſuch of the fluids as paſs through them a ſecond or a third time.

THE ſecond branch of the office of the veins is, to elaborate the fluids into that form and compoſition which we know by the name of red blood. That this is the peculiar province of the veins is ſelf-evident, I apprehend: For though there may be accidentally a continuation of ſome arteries containing red blood in veins, yet it is certain there cannot be a continuation of ſuch a quantity as to ſupply the twentieth part of the red blood found in the larger veins. It muſt therefore be concocted by the veins out of the finer fluids which they receive by abſorption or otherwiſe.—In ſhort, the ultimate office of the arteries is to reſolve the blood into the various animal fluids and ſecretions; and the buſineſs of the veins is to combine and regenerate them again into red blood; for the arteries generate none, they only receive it already compoſed.

The blood, then, in the *vena cava aſcendens* is not only perfectly animal itſelf, but it receives an acceſſion of blood from the liver, which is ſtill more highly animalized, having undergone a complete courſe of both arterial and venous circulation a ſecond time; by which it becomes ſo highly exalted as not only to tend to diſſolution itſelf, but to affect the reſt of the blood with the ſame diſpoſition, if it was to perform its courſe through the heart and arteries again without the ſupplement of freſh materials taken into the ſtock, which moderate its tendency, and furniſh it with qualifying combinations, or mixtures.

On the other hand, though the blood of the *vena cava deſcendens* muſt be as perfectly animal as that in the *aſcendens*, yet its nature is no leſs diluted and and let down, by the conſtant acceſſion of freſh chyle poured into the left ſubclavian vein, than the blood of the *cava aſcendens* is exalted, by the acceſſion of the hepatic blood.

THESE two then guſh into the firſt chamber or right auricle of the heart; there they are confounded, and undergo firſt the conquaſſation of the auricle throwing it into the ventricle, and then the conquaſſation of the ventricle intimately mixing the two differently diſpoſed liquors, and throwing the compound out by the pulmonary artery, through the whole ſubſtance of the lungs, even into, I had almoſt ſaid, poſitive contact with the air we inſpire.

THE great and important intention of this courſe of the blood through the lungs is in order to ingroſs another ingredient, namely a portion of freſh common air, at each inſpiration, into the compoſition, in exchange for an equivalent portion of the moſt volatile effluvia of the blood, exhaled from the lungs at every expiration. With this addition, the blood is returned again from the lungs by the pulmonary vein, into the outer of the ſecond pair of chambers of the heart, called the left auricle, where again it is agitated, or churned, and thrown into the left ventricle, where it ſuſtains a freſh commixture by the contraction of the ventricle, which paſſes it at the ſame time into the great artery, called the aorta.—By theſe means the heterogeneous parts of the blood are ſo blended as to prevent the homogeneous parts from aſſociating or combining, as they would be apt to do; and inſtead of that, they are diſpoſed to that common elaboration and influence upon each others different qualities, which renders the whole maſs fit for, and more ſuſceptible of, the various changes and ſecretions it is intended to undergo in its courſe.

Many phyſiologiſts have ſuppoſed the blood to undergo an actual fermentation, which implies a change of its nature, in the heart; but the ſtay of every portion of it there, is ſo momentary, and the mechanical agitation it is there put into, is ſo great, that that ſuppoſition is next to impoſſible; the animal changes not being ſo rapid as in the ebulitions of naked alkalis and acids.—There is no doubt however but that agitation is intended, not only to augment the heat of the blood, which diſpoſes it to preſs outward, as all heat in bodies under its influence does, but ſo to mix the heterogeneous part, as to prevent any combination of ſimilar parts, which might obſtruct their ſo readily yielding to the animal mutations and exaltations they are deſtined for, under the influences of the powers of life.

There is another circumſtance in the ſtate of the blood paſſing the heart, unattended to, which renders the ſhocks it receives there very neceſſary, and that is the great quantity of the fluids which are in the ſtate of ſmoaking volatile effluvia, and the great tendency of all the parts of the blood, that are not combined in gluten or in red particles, to expand themſelves into that ſtate.

If the blood was not thus mixed, and theſe effluvia kept equally diſperſed among the other parts, portions of the effluvia would be apt to collect into an elaſtic maſs by itſelf, and very ſuddenly coagulate or otherways ſtop the courſe of the reſt of the blood. It is this accident, this elaſtic force of the effluvia, that ſometimes burſts the heart contracting upon it, and becomes the occaſion of the moſt ſudden of all deaths, commonly, though falſely, imputed to an apoplexy.

The large quantity of fluids diſpoſed to expand into vapour is eaſily demonſtrated in the extremities of the body, by the great expanſion of the veins beyond their natural ſize, whenever the parts are expoſed to a greater than ordinary heat. On the contrary, in a ſtate of greater than ordinary coldneſs, the veins collapſe ſo much as to be ſcarcely diſcoverable.

ELASTIC vapour and air have been ſo confounded in all ages, on account of their common property of elaſticity and expanſion by heat, that it is with ſtricter propriety, or at leaſt with a more direct reference to this circumſtance, than we now apprehend, who have loſt ſight of that predominant quality in the blood, that the Ancients, eſpecially regarding it, gave the name of arteries to that ſyſtem of veſſels into which the heart throws the blood; at the ſame time implying the air taken into the blood from the lungs, which it is part of the office of the arteries to ſubdue, ſo as to render it a conſtituent part or agent in the proceſs of animaliſation. The preſent philoſophy would call this, rendering the air in the blood *fixed:* But I have not ſo clear conceptions of that matter ſo as to authorize me to adopt the phraſe *.

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* The fixed air which has become ſo faſhionable a ſubject of inveſtigation of late, ſaid to be ſo noxious in the form of air, and ſo ſalutary united again with water or other fluids, is nothing elſe than a highly volatilized and active mineral acid, in the ſtate of its firſt remove from, or laſt approach to the form of phlogiſton. In all effervеſcence, during its action, ſome of the acid particles become ſo irritated, by the impetuous neutralization of others, that they are rendered highly volatile, collect in the fluid into little parcels of ſteam incloſed in ſmall aqueous bubbles, which riſe through the liquor, and break and diſcharge their effluvia on the ſurface of it. Of the ſame nature (only produced from vegetable ſubſtances) is that gas generated in and iſſuing from fermenting liquors. I remember, ſome years ago, to have ſeen a real kind of dulcified acid ſpirit diſtilled from a fermented, or rather fermenting, liquor; the ſingular taſte of which I taught the diſtiller to correct, by mixing ſome abſorbent with the ſpirit. I am perſuaded that ſuch an expedient for correcting ſuch accidents, can be no ſecret to the diſtillers by trade. If Gentlemen of a philoſophical turn would, in their reſearches,

THERE is one other conſideration which ſuggeſts to us a very ſtrong preſumption, if not proof, of the large pro-

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ſearches, converſe more with tradeſmen, they would often find ſolutions of very obſcure problems in their practices. Sir John Pringle's fair and accurate hiſtorical detail, at the conferring the Royal Society's laſt premium on Dr. Prieſtly, of the ſlow progreſs made in the ſtill imperfect diſcovery of the nature of Fixed Air, or mephitic air, is a ſtriking proof, that there is no unlocking Nature's ſecrets without a key, nor ſearching into them without a light: without theſe we may torture Nature by our experiments long to little effect. Whereas the diſcovery of the proper key would ſave a great deal of that trouble, and it is often very eaſy to be found.

The fire-damp in coal mines is a highly elaſtic petroleous effluvia, burſting from deep ſeams of fatter and leſs conſolidated veins of coal, by reaſon of the want of a ſufficient reſiſtance or circulation of the common air in ſuch mines. The ſteith or mephitis is dephlogiſticated ſulphureous vapour, generated in a like manner in other mines.

The three mineral acids are the univerſal acid, diverſly modified by ſubterraneous, marine, or aerial concoction. In the form of vapour they are all ſtrongly elaſtic, and have been miſtaken, under certain circumſtances, for ſpecies of air. Each of theſe acids gives a ſpecific modification to phlogiſton; which they all either cloſely unite with, or comprehend in themſelves, as ſomehow eſſential to their conſtitutions.

portion of this elaſtic vapour in the blood, and that is the proportions of the cavities of the heart to the proportion of blood that can be ſuppoſed to paſs through it every pulſation.—I have not the leaſt heſitation in declaring it abſolutely impoſſible, that the auricles and ventricles of the heart receive and diſcharge either one-half or one-quarter of the quantity of blood it would require to fill them, at every pulſation.—The unequal ſizes of the cavities of the heart, among themſelves, is a certain proof of this.—Another is, the impoſſibility of even half a ton, far leſs two tons and an half, of blood paſſing through the lungs in the courſe of twenty-four hours.—One principal object, therefore, of the diſproportion between the ſize of the cavities of the heart, and the quantity of blood they muſt receive between every pulſation, muſt be to give room for the expanſion of the effluvia in the blood, that, by the contractions of the heart, it might be employed to divide the blood more effectually, and be mixed with every portion of it more intimately.

I SHALL conclude this diſcourſe, with a remark upon this propagation of animal life and motions by alternate action and remiſſion of action, both in the brain and heart.—I will ſay nothing of the primary cauſe of it; nor will I enquire how far it is, or whether it muſt not be, if abſtractly examined, the neceſſary mode of all action. Only this we may venture to ſay, that it ſeems to be a favourite mode of ſupporting nature, both in the great world and in the little world, as the human frame is often called.—The final cauſe, or the end for which it is eſtabliſhed in our frame, ſeems to be for the more effectual relief and ſupport of nature, when it languiſhes, or is in hazard of being overpowered, or the motion of the fluids ſuſpended and ſtopped by any ſudden accident; as in the caſes of great fear, horror, grief, or any extreme agony or ſtruggle of contending paſſions.—When the native vigour of the ſolids, and nervous ſyſtem, in ſuch caſes, becomes relaxed, and loſes that reaction on the fluids, which is neceſſary to preſerve their motion; then the heart throbs, palpitates, and redoubles its efforts to revive the languiſhing motions, warmth, and vigour of every part.

In ſuch caſes, it is evident, the redoubled action of the heart is not from an encreaſed quantity of fluids brought to it, but the contrary; and the immediate encreaſed acceleration of its contractions is not ſo much to fill the veſſels, which muſt be ſuppoſed fuller than before the conſtitution fell into theſe circumſtances, but to react upon the languiſhing ſolids, and re-animate their proſtrate vigour:——a certain proof this, that the actions of the heart have as immediate, nay a more immediate, connection with the nervous ſyſtem, the ſecretories of life, than with the immediate motion of the fluids as a mechanical cauſe thereof.

In ſhort, the reſpective powers and compounded influences of the brain and the heart upon the human frame, may, with great propriety, be compared to the agency of the ſun and moon upon the great world.—The ſun pervades all nature, and ſheds his influences in its moſt intricate receſſes, elaborating out of one whole, according to its various circumſtances, and aſſortments, an infinite variety of properties and forms: while the moon, by a ſpecial regulation and flexion of his influences, diſpoſes that great maſs of fluids, which are the immediate organs of his energy, and the ſubject of all his operations and productions, into theſe tides and reciprocations of ebbing and flowing, which is, according to the conſtitution of things, ſo neceſſarily ſubſervient to their being conveyed in a proper diſpoſition, into all theſe elaboratories into which the ſun, from whom nothing is hid, reaches.

JUST ſo in the microcoſm, the brain, by the mediation and irradiation of its nerves, penetrates and animates every point of our frame, and particle of our compoſition, diſpoſing every fluid particle to a ſpontaneous motion and accommodation of its nature to the character and ſtructure of the parts to which it attinges; while the heart, by its reiterated impreſſions and ſhocks on both the ſolids and fluids of our ſyſtem, gives an additional vigour to the animation and diſpoſitions of the whole, and cauſes theſe perpetual colliſions which irritate and invigorate the living flame that is glowing in every part.

I CANNOT, Gentlemen, take upon me to warrant the infallibility of every thought or ſuggeſtion I have riſked in this lecture; and the compaſs it reſtricts me to, has debarred me from further enlargement upon any of them. Several of theſe may be allowed to be problematical, without the main queſtions being affected thereby; but I perſuade myſelf that I have proved both, my general propoſition, and the ſeven inferior ones, under which, for the greater clearneſs and diſtinctneſs, I have diſtributed the evidence.—I have delivered my ſentiments on this ſubject with the greater aſſurance, that they have the ſanction of my friend Dr. Hall's approbation, whoſe judgment and abilities, independent of our friendſhip, I very highly eſteem———

FOUR LETTERS

ON THE

NATURE and CONDITIONS

OF

LIGHT AND AIR.

ADDRESSED TO

Sir HILDERBRAND JACOB, Bart.

FOUR LETTERS,

TO

Sir HILDEBRAND JACOB, Bart. &c.

LETTER I.

Of the Materiality of LIGHT.

SIR,

I HAVE taken occaſion from my ſubjects in the preceding ſheets to diſcourſe of Light ſo particularly as related to the human frame, and as conſtituting both materially and virtually the moſt important part of our compoſition; and I have purſued theſe views ſo far, that I find it neceſſary to ſay ſomething of its abſolute nature and conditions; in order to remove, as well as I can, any obſcurities or difficulties that may ſtill ſeem to attend the ſubject.

PERMIT me, therefore, to addreſs to you ſome thoughts in proof of the *materiality*, the *plenitude* and of the *poſitive activity* of light abſolutely or univerſally conſidered; becauſe they are principally extracted from a work, which tho' not finiſhed, was long ago undertaken and begun under the favour of your auſpices.

ARISTOTELIAN tho' it was, there was a great deal of ſhrewdneſs and ſagacity in that old metaphyſical definition of Light implied in the term *materia media*, intimating that it was a ſubſtance related in ſome manner both to *Spirit* and to *Body*. By an infinite ſeries of ſenſible effects with which univerſal nature is momentarily every where teeming, whoſe cauſes elude all poſſible perception, Light, the fountain of them, juſtly deſerves the name of *Anima*. But the great and reverend Antitype of this wonderful principle of nature, to prevent

vent all miſtakes, has provided that ſome of its endleſs modifications ſhould yield us ſatisfactory demonſtration of its being Body and not Spirit, and of its operations being mechanical and not rational.

MECHANISM bearing immutably the ſame relation to material principles as reaſon does to ſpiritual ones, mechaniſm becomes a certain medium for aſcertaining the materiality of principles that act or are acted upon by its laws.

THAT Light and Fire are ſubſtantially or materially the ſame, is evident from their commutability or their reciprocal generation of each other. For as fire neceſſarily generates Light, and diſcovers itſelf to the ſenſe of ſeeing as infallibly as to the feeling; ſo light, converged into a focus, conſtitutes pure elementary fire, without the interpoſition of any medium or other ſubject neceſſary for its ſupport. Again, Light and

Heat are propogated by the ſame laws. They act in ſtraight lines—They diffuſe themſelves from a centre outward—Their powers decay according to their diſtances from the centers from which they are irradiated—They are ſubject to the ſame laws of reflection.——

AGAIN, the ſenſes which we are provided with to acquaint us with the powers of light or fire, are formed upon the plan of the moſt exact and refined mechaniſm, and therefore are prepared only for the impreſſions of what is ſtrictly and properly material.

SIR, theſe few circumſtances, without the neceſſity of any commentary or enlargement, are fully ſufficient to certify deciſively to our reaſon, that light and fire are ſubſtantially the ſame, and that that ſubſtance is a material or corporeal one.

I am, SIR, &c.

LETTER II.

Of the Denſity of LIGHT.

SIR,

IT is a very natural queſtion, and of very great phyſical importance to be decided; in what proportion, as to quantity, does this matter exiſt in the univerſe? It muſt be owned, that Sir Iſaac Newton has out-done himſelf in his Theory of Light and Colours, as much as he has excelled others in his other works. Nothing can be finer, and a greater diſplay of his extenſive genius, than his Optics, notwithſtanding his Theories being clogged with unſurmountable difficulties; ſome of which I beg leave juſt to mention to you.

FIRST, The immenſe velocity he aſſigns to Light, not only exceeds all credibility, but it is abſolutely impoſſible:

Neither the tenuity of its parts, nor the rarity of its rays can abſolve it from tearing to pieces and diſſipating in a moment all terreſtrial ſubſtances: Whatever power it is that gives the denſeſt bodies their conſiſtence and fixation, yet we know that it is a limited one, and one whoſe limits bears not the proportion of one thouſandth part of the momentum with which the rays of Light iſſuing directly from the Sun, upon Sir Iſaac Newton's computation of their velocity, ſtrikes every point of their ſurface, and penetrates every pore in their ſubſtance.

SECONDLY, This velocity, according to Sir Iſaac's ſcheme of it, is reduceable to no poſſible mechanical regulation. It moves juſt as faſt by reflexion from the coldeſt ſubſtance, as from the boiling furnace of the ſolar fire. Who can believe that a glow-worm has a power of giving Light the ſame unconceiveably intenſe quantity of motion, that a centre of fire animating the whole univerſe has?

THIRDLY, Who can conceive it poſſible that a fluid, ſuch as Light, which does not exhibit one ſymptom of the very weakeſt degree of any coheſion among its parts, ſhould keep with ſuch unvariable regularity, moving rank and file, in diverging lines? Can we ſuppoſe that the particles of boiling water, vomited from the mouth of a volcano, can preſerve any relative order in their eruption?

FOURTHLY, This impoſſibility preſſes ſtill harder upon us, when we extend the unconceivable regularity of this progreſſion ſo far, as to allow it ſuppoſible, that the ſeven threads of which every ray of Light is compoſed, ſhall immutably retain their lineal order and relation without any poſſible confuſion, or jumbling together beyond all poſſibility of regular analyſis. We may as well ſuppoſe it poſſible that the ſpirit, the acid, the ſugar, and the water, in boiling punch, can be ſo diſtributed in boiling thro' a funnel as to preſerve each their relative order of affinity in the midſt of their tumultuous confuſion. Theſe things cannot be.

FIFTHLY, How can it be conceived that the principle of attraction which, at any ſmall aſſignable diſtance, ſuppoſe the three hundredth part of an inch, is infinitely weaker between bodies than the momentum of Light moving at the rate of fifteen hundred thouſand miles in a minute, or fifteen thouſand miles in a ſecond of time, ſhould yet at ſuch a diſtance ſenſibly bend and incline the atoms of Light in ſuch a rapid motion, off the ſtraight line? mathematics themſelves reclaim againſt the poſſibility of ſuch a propoſition.

Lastly, I have always deemed it the moſt inconceivable and incredible of all the myſteries that ever philoſophy propounded to human credit, that *nothing*, or the ſuppoſed empty ſpaces in coherent bodies, can have a power of reflecting rays of Light impinging with ſuch infinite momentum againſt it.

I do not, Sir, I cannot doubt of the phœnomena that have ſuggeſted theſe inferences; but they being phyſically impoſſible, there remains no other way of explaining them than by concluding, that Light exiſts in ſuch a condition as to quantity, as can be ſuppoſed to produce theſe phœnomena without the neceſſity of having recourſe to impoſſibilities.

A plenum of Light will account for the phœnomena; and no other ſuppoſition can do it. Admit the ſuppoſition of a plenum to be clogged with difficulties to our conceptions;

ſtill it is embarraſſed with none ſo repungant to the nature of things, as the ſuppoſitions I have mentioned. A plenum will account for an inſtantaneous impreſſion of Light upon our ſenſes by the remoteſt objects; and it is much more natural to ſuppoſe, that certain circumſtances in ſome immenſely remote caſes, may make us apprehend that ſome ſmall time is ſpent in its tranſmiſſions, when in a plenum it ſhould be inſtantaneous, than to ſuppoſe that any body can move thouſands of miles in the twinkling of an eye.

A PLENUM is no way inconſiſtent with Lights acting in ſtraight lines on our ſenſe, or with its being put in action in either diverging or converging lines: But it is impoſſible that out of a plenum, a fluid with no lineal adheſion can fly away to all diſtances in ropy tenacious-like threads, incapable of being confounded or deranged.

ranged. In ſhort, a plenum tends to contravert none of the phœnomena of Light and Colours; tho' I confeſs it will alter the interpretation of ſome of them. If there is apprehended any inconvenience in that, it is only ſuch an one as will initiate us into more knowledge upon that ſubject.

I KNOW the only plauſible objection againſt a plenum that ever could be urged, is the difficulty of conceiving the poſſibility of motion in one. Indeed, if *Attraction* is, what ſome philoſophers have now pronounced it to be, an eſſential adjunct of materiality; there can be no diſtinction between an univerſal plenum and an univerſal ſolid. But as I take ſolidity to be like all the other various modifications of bodies, a phyſical reſult of the compoſition of nature; Solidity and a Plenum have no connection with one another in my ideas. But let us take nature as it is, and according to it, examine the weight of this objection to a plenum.

Formerly philoſophy accounted water itſelf ſo completely a plenum as to pronounce it incompreſſible; yet ſtill in that ſtate it remained a fluid ſuſceptible of an internal motion of all its parts. Now, indeed, they ſay it is capable of ſome degree of compreſſion, and I fancy, if they will put it into circumſtances proper for ſubjecting it to the experiment, they will find it elaſtic alſo. But whether theſe things are ſo or not, they do not affect my argument; for the internal motion of a plenum of water can be aſcertained by bodies moving in it, that have no power to make room for themſelves by compreſſing it. Water then is ſo far a plenum, that it is ſcarcely compreſſible. This water, as hot as boiling, is ſuch a plenum in a conſtant internal motion of all its conſtituent parts. The Light paſſes as regularly and tranſparently thro' a glaſs of boiling hot water, as if it was a piece of ſolid chryſtal.

THE Light paſſing thro' a piece of chryſtal may be explained by the pores of the chryſtal lying in lines parallel to the lines of Light; but this will not ſolve the phœnomenon of the Lights paſſing in ſtraight lines thro' a boiling hot fluid, whoſe pores cannot continue one moment in the ſame parallel poſition to one another. If then, this marvellous fluid can preſerve its action as Light uninteruptedly, thro' a plenum whoſe internal parts are in perpetual motion; is there any wonder, that in the pure medium of its own plenum, it ſhould make its impreſſion on our ſenſes in the direction of rays or lines, without the neceſſity of ſuppoſing its operations muſt be diſtracted, becauſe they are performed in a plenum; or without the neceſſity of ſuppoſing that every atom of Light that delineates on my eye the ſenſe of an object, muſt have been iſſued or reverberated from that object, in the ſame manner that a ball toſſed againſt a wall, recoils back into the hand again?

I BEG leave, Sir, to add, that there is no occaſion for any other argument to decide the exiſtence of a plenum of Light or Fire, but thoſe mentioned in my former letter in proof of its materiality. For mechaniſm as neceſſarily implies plenitude of matter, as it implies materiality itſelf. It cannot ſubſiſt but where the parts of the machine are in conſtant influencing contact with one another every where. This is ſtrictly all the definition that can be given of a plenum.

IT is very remarkable, Sir, that though the doctrine of a plenum was very general, nay, almoſt univerſal among the Ancients, is was held amongſt

mongſt them as a matter of fact they were convinced of; rather than as an Hypotheſis they had much uſe for in philoſophiſing. Had they connected the idea of mechaniſm with their acknowledgment of a plenum, they would have perceived preſently, that they had no occaſion for aſſumimg the Hypotheſes of occult qualities, or of motions being eſſential to matter; which was the opinion of the Epicureans, and is ſaid alſo to have been the opinion of Democritus, Leuſippus and I believe of the Phœnecian Moſchus alſo—in ſhort of all the Atomiſts.

It is generally believed, but without ſufficient foundation, that theſe Atomiſts maintained the doctrine of a vacuum in the ſame ſenſe in which it was revived among the Moderns by Gaſſendus, and now forms a fundamental doctrine in our ſyſtem of phyſics. But it is evi dent from *Lucretius*'s manner of reaſoning in defence of a vacuum, that the Epicureans meant no more by it, than ſuch a vacuum as they conceived to ſubſiſt within the ſubſtance of water, or of any fluid; whoſe parts are, nevertheleſs, all apparently in contact with one another, which is all the plenum that is required in a mechanical ſyſtem.

HAD the Ancients only conceived that a plenum was ſuſceptible of ſtructure and mechanical arrangement, their ſyſtem of phyſics would have been complete, which, by their not comprehending that important circumſtance, was very imperfect.

I am SIR, &c.

LETTER III.

Of the ACTIVITY of LIGHT.

SIR,

WHEN a plenitude of light is confeſſed and admitted, it remains a point of no ſmall importance in phyſics to be determined, in what condition, in reſpect of reſt or motion, does this fluid always exiſt? All fluids we are acquainted with, when undiſturbed, have the ſame appearance of both ſuperficial and internal quieſcence that a ſolid has. We know that all fluids are endowed with a mobility of their parts, but they are not generally ſuppoſed to be in actual motion, ſave when they are diſturbed or agitated.

OF all fluids known in the univerſe, the mobility of light is the greateſt. It may, with the ſtricteſt propriety, be ſaid to be poſſeſſed of mobility in the abſtract. There is not the ſmalleſt ſpeck of colour, nor a viſible mote in the beams of the ſun, that it does not obediently receive perpetual impreſſions from in all lineal directions, by night as well as by day. The ſun, as a fountain of motion, alſo, is perpetually agitating it either radially, or obliquely by the lateral ſhocks and friction of theſe radii upon theſe parts of the fluid that lie out of the line of, or are ſhadowed from the ſun's irradiation. In like manner, the remoteſt fixed ſtar is not without its influence upon the light's mobility. Therefore, conſidering this inconceiveable mobility in the light, the infinitely various impreſſions it is conſtantly receiving, it cannot otherwiſe be, than that it ſhould conſtantly be in a ſtate of internal motion of its parts.

BUT all this is vaſtly inſufficient to convey to us any adequate idea of the conſtant, poſitive, intenſe energy of the activity of the light; which we may more eaſily form ſome conception of, by examining into the mode of its poſſeſſing the interior parts of all other the moſt rigid and ſolid bodies. This I ſhall illuſtrate in the caſes of ſonorous bodies, and from the phœnomenon of hammering cold iron red hot.

If it was not irrational, when we know of one ſenſible univerſal fountain of motion which ſheds its energy thro' all nature, to ſuppoſe that motion can be a property of matter inſeparable from its exiſtence, one would be tempted to think with Epicurus that motion really was of the eſſence, if not of all matter, at leaſt of the matter of light. Even in the moſt ſecret receſſes of the moſt ſolid and paſſive ſubſtances, light is ſo far from exiſting in an indolent quieſcent ſtate, that it is impoſſible to form an adequate idea of its inceſſant active energy under theſe circumſtances.

It is conſtantly acting with ſuch power within the moſt denſe terreſtrial ſubſtances, that when all the phœnomena belonging to them are duly weighed, it may be a queſtion whether any two terreſtrial atoms of matter are in poſitive contact with one another. This ſtate of bodies is little thought of in our reſearches into their properties, either common or ſpecial.

If light reſided within bodies in an indolent paſſive ſtate, it could exert no reluctation to any external mechanical force diſturbing its paſſive occupation of its ſpaces within bodies. But in fact, its natural ſtate there is never diſturbed without an irritation being excited in that fluid, greater than that with which it was expelled, to recover and repoſſeſs its organical and interſtitial inherency: it returns with a force not barely ſufficient to recover the dimenſions it occupied within bodies, but with a violence able to expand them as much be yond their natural ſize as any external blow or concuſſion tended to compreſs them within it: ſo that a vibratory colluctation between that action which preſerves bodies in their natural craſis, and the rapid returns of light to its natural ſtate is raiſed, which continues for ſome time, and dies away imperceptibly.

THIS intenſe agitation, excited by the colliſion of bodies, is not confined to their points of contact, but pervades their whole ſubſtance, and oſcillates in every part.—We have demonſtration of this both to the eye and to the ear, when a muſical chord is ſtruck. In all elaſtic bodies that are ſonorous, we have ſpecimens of the ſame.—When a bell is ſtruck, the ſound continues labouring in the ear for a conſiderable ſpace of time afterwards; nor is the tumult compoſed, when our ſenſe of it fails; it paſſes through a gradual decay below the ſtandard of ſenſe.

IRON is a metal that diſcovers no great degree of this ſonorous quality, yet when a poker is held ſuſpended by the head between one's teeth, and is ſtruck in that ſtate of ſuſpenſion, the holder of it has a very ſtriking feeling of the vibratory motion its whole ſubſtance conceives from the ſtroke, by the teeths tranſmiſſion of their feeling to the ears.

PHYSICIANS talk of the irritability of our nervous ſyſtem as a very myſterious and wonderful phœnomenon, but we have ſtill more ſtriking examples of this irritability in the moſt rigid dead ſubſtances. Subſtances, ſuch as bell-metal, glaſs, &c. which, tho' they are ſo rigid that almoſt no inſtrument will make an impreſſion on them, are yet capable of being agitated through every atom of their ſubſtance; nay, in ſome caſes, to be burſt in pieces by the very impreſſion of certain ſounds upon them. A wine glaſs will burſt in pieces by the action excited through its ſubſtance, by certain tones of the voice; and when the vibrations of ſound are excited in the ſtrongeſt bells, a very ſlight reſiſtance to that internal agitation is ready to crack them;—a pack-thread faſtened tightly about them, I have been told is ſufficient to do it.

THIS exceſſive mobility of parts throughout the whole ſubſtance of the moſt rigid bodies, ſeems to imply ſo great a turgency of their ſubſtance with ſome very active fluid, that a ſmall encreaſe of it would be ready to burſt them in ſhivers, as actually happens to theſe glaſs drops, let fall into water when they are red hot, whenever the ſmall thread formed at one end of them by the tenacity of the ſemi-liquid glaſs, is ſnapped.

IT is impoſſible to conceive how ſuch a tremulous motion ſhould be produced through the whole continuity of ſuch hard bodies, unleſs they contained in themſelves ſome inconceiveably active element exerting a conſtant niſus to force their parts at as great a diſtance from each other as poſſible, and that was barely counteracted by the power that maintained their coheſion.

The ſymptoms of this reſtleſs activity within ſolid bodies are not confined to ſuch as are commonly called elaſtic. Iron is more denſe than any body of greater elaſticity than itſelf; at the ſame time, it is conſiderably plaſtic or ſuſceptible of extenſion by hammering, &c. yet it yields ſtill more ſtriking proofs of this latent active principle, than any moſt elaſtic body can do; and ſuch at the ſame time as diſcloſes to our ſenſible conviction, preciſely what that principle or reſtleſs element is, that exerts its energy ſo powerfully within all terreſtrial bodies.

We are apt to conclude that when any plaſtic body is ſo preſſed by any external application, as to make it change its figure and the internal relative arrangement of its parts, that all is immediately at reſt within it, and that the whole immediately acquieſces in the form it receives. But this is by no means the caſe. That power in bodies which ſuſtains and preſerves their form, is not a paſſive one. It is a poſitive re-action to the parts of bodies approaching nearer each other than they naturally do; or, in other words, which reſiſts their approaching ſo near one another as they would do, if that re-acting element was not interpoſed among their parts.

The law of re-actions being equal to action, reſides ultimately in the conſtitution of this powerful fluid medium. Whenever the ſpaces it occupies within the ſurface of bodies are preſſed nearer one another by any ſudden ſhock or colliſion, and conſequently this medium is for an inſtant wrung out, the next inſtant it returns with violence not ſufficient to regain its natural room in the body, but with violence equal to that with which it was ejected; and therefore in returning, it dilates its ſpaces as much beyond their ſizes, as they were compreſſed below their natural ſtandards by the colliſion: by which means a temporary oſcillation is excited between the efforts of that power which circumſcribes bodies, and binds them to their natural ſizes, and the internal medium which was irritated by the ſtroke to re-act with a force equal to it.

If theſe ſtrokes which diſpoſſeſs this fluid of the ſpaces it naturally obtains within bodies, are quickly ſucceſſively renewed, before the colluctations raiſed by the former ones have ſubſided; the internal agitation can ſoon thereby be raiſed to ſuch a height as to break forth, and manifeſt itſelf in the form of actual fire. The moſt obvious and ſenſible demonſtration we have of this, is in the beating of a piece of cold iron red hot.

A PIECE of iron briſkly hammered on the anvil, acquires an encreaſed degree of heat by every ſtroke given it, until it becomes actually ignited. Real fire in all its characters is diſcloſed by the repeated action of two cold bodies upon one another. The fact has been long well known to the ignorant as well as to the learned ; but the inferences it neceſſarily yields, ſeem to have been as little adverted to by the one as by the other. But knowledge will make quicker advances by reaſoning upon known facts, than by diſcovering new ones, which though they enlarge and add to the ſubjects we ought to reaſon upon, are apt by their novelty to ſurpriſe us into haſty undigeſted theories and hypotheſes.

Now, as heat is known to expand and enlarge the volume of all bodies, and as every degree of external violence upon bodies muſt have a determinate degree of tendency, however imperceptible, towards the ſame effect; it follows, that every degree of external force ſufficient to diſturb their natural craſis, muſt have a conſequential momentary effect in encreaſing their ſizes. —As an inference, the fact appears certain and intelligible; but as an unexplained propoſition, it would appear a paradox, more likely to be rejected as falſe, than to be admitted as a truth capable of interpretation.

It may not be impoſſible, from the above mentioned known experiment of the beating cold iron hot, to fall upon a medium for calculating what quantity of mechanical force is equivalent to that quantity of motion in light which produces any given degree of heat. The phœnomena of elaſtic and ſonorous bodies likewiſe ſerve to illuſtrate the preciſe nature of irritability in animal bodies, and may likewiſe be of ſome uſe in unfolding what muſt be the particular conſtitution of the parts in which it reſides, and to what the different degrees of it in different animal parts and in different conſtitutions is owing.

As this univerſal fluid is known only by its ſenſible effects, therefore, from theſe, we are obliged to denominate it, LIGHT or FIRE: and I have ſhown in ſome degree, what teſtimony they bear to the amazing intenſeneſs of its perpetual agility. There is another attribute which it is no leſs diſtinguiſhed by, though leſs attended to, namely POWER. But to open this ſubject fully, would be to diſcuſs the whole ſubject of natural ſcience. The ſtrokes of the power of this element is well known in the effects of lightening, but theſe I do not ſo immediately refer to. It is the baſis of the power of all other bodies: upon it their ſtability depends. It daily forms what no other power can change; and what no other power can change, it transforms in a moment.

I am, SIR, &c.

LETTER IV.

Of AIR.

SIR,

NO length of time can entitle an error, even in the terms of phyſics, to preſcription. I do not know how old the impropriety is, but it certainly is a very groſs one, to call air a *fluid*. With the ſame propriety, ſmoke iſſuing out of a chimney may be called a fluid.

EXPERIMENT has never yet been able, nor, I believe, never will be able to condenſe air into a fluid, or to bring the conſtituent particles thereof into contact with each other.

Even the particles of a proper fluid, when in a ſtate of vapour, poſſeſs one property eſſentially different from fluidity. They are not only not in contact with one another, but they have no niſus or tendency to come into it, or draw nearer each other, when they have free room to expand: then, they invariably exert a niſus, or a niſus is exerted upon them to ſeparate more and more. In this, proper air agrees with vapour or elaſtic effluvia, and therefore it has no title to the appellation of a fluid.

Whilst philoſophy has confounded air with fluids on the one hand, it has been, and is at preſent, very buſy in confounding it with vapour on the other hand. Hence, phyſics are juſt now over-run with a multiplicity of *airs*; becauſe there are few conſiſtent bodies but what, by a proper enchercisis, may be made to yield a volatile elaſtic vapour.

It was always well known to a claſs of philoſophers now out of date, that the parts of all conſiſtent bodies were bound together by a ſecret acid principle; an embodied ether, which acts as the great principle of adheſive attraction every where. When this is unbound, it manifeſts itſelf in the form of an elaſtic acid vapour, coercible in different degrees, according to the nature of the bodies it is expelled from.

This acid principle is ſo univerſal, that it is known to lodge in all alkalis themſelves, excepting calcified ones; and calcification is no more than expelling this acid from calcareous alkaline ſubſtances. To the particular modification of this acid in the ſulphur of iron, is owing the principle of magnetiſm itſelf.

THE nature of acidity has not been ſufficiently enquired into. Phyſicians ſay acids are cold, and preſcribe them with that intention. Chymiſts ſay they are hot, and burn every thing. Concentrated, they have a corroſive burning attraction; diluted, they cool by attraction, damping and fixing to themſelves theſe particles of ſubſtances which have generated moſt heat, or have the ſtrongeſt tendency to do ſo.——What is the reaſon that both lightning and electricity often excite a ſulphureous ſmell?

IT was an old opinion in phyſics, that common air is impregnated either with the nitrous acid, or with nitre itſelf: hence the phœnomenon of freezing was explained by that hypotheſis. That there is an affinity between the nitrous acid and common air is highly preſumeable: but it is much more likely that that acid is the univerſal acid, aſſociated with ſome particles of the common air, than that common air is that acid.

THE common air may not improperly be called the phlogiſton, without which no other combuſtible ſubſtance containing the terreſtrial phlogiſton, can deflagrate or be conſumed.

THERE is one property or character of common air, which eſſentially diſtinguiſhes it from all other known ſubſtances; and which naturaliſts ſhould have ſatisfied themſelves, whether any of their elaſtic effluvias poſſeſſed, before they had confounded them even in name with the common air.—Common air as invariably ruſhes into a fire, or preſſes toward any ſuch centre of motion, as all other ſubſtances recede, or are impelled by the receding energy of light, from ſuch a centre.

THERE is a very obvious phœnomenon, which yet I do not remember to have been noticed by any naturaliſt; that ſeems to inſtruct that we are conſtantly receiving recruits of common air, if not from water, at leaſt from the earth, through the water that covers it. Ice is well known to be full of air bubbles; and that theſe are not generated in or extricated from the water immediately freezing, is evident from this obſervation. By examining a pond or any piece of ſtanding water, whoſe bottom is covered with ſtones of different ſizes, after it is frozen over, one will always obſerve the air bubbles in the ice over the ſtones, larger both in ſize and in quantity; not indeed perpendicularly over the ſtones, but collected in irregular circumſcribing lines, defining both the form and the ſize of each ſtone; which ſeems to imply that the air aſcending out of the earth, where the ſtones lie, through the water, is turned from its perpendicular aſcent by the ſtones, and then riſes perpendicularly round their edges towards the ſurface, till it is arreſted by the ice on the ſurface.

If we could pay a quick and ſagacious attention to the proceſſes that Nature is conſtantly carrying on, on every hand of us, we might be ſtocked with an endleſs fund of inſtructing obſervations and phœnomena, without the expence of an apparatus for them.

I hope, Sir, you will excuſe me for the liberty I have taken to trouble you with theſe thoughts on Light and Air, that are thrown but unartfully together in the foregoing letters.

I am, with reſpect

and eſteem, Sir, &c.

I N D E X.

A

ANATOMY, its Uſe and Limits, page 68
Animalcula, - - - - 70
Animal heat, its Seat, - - - 124
Ancient Phyſicians defended - 126, 129, 132

B

Bath and Briſtol Waters, the cauſe of their heat explained, --- --- 127
Blood, the immediate office of it, for preſerving Animal heat, --- --- 130
Blood, its conſtituent parts, and the different properties of each, -- -- 134

C

Conſtitution of Sexes, how far common, 36
————Peculiar to Females in Body, 39
——————————Mind, 56
Celeſtial part of Animal Conſtitution, -- 43
Character, Female, --- --- 68
Conception conſtitutes it, --- -- 72
Conception what, --- -- 73
Coagulum, its properties, --- --- 142
——Uſes, --- --- --- 144

D

Diſeaſes, cauſes of them, peculiar to Females, p. 61

E

Earth, formally no conſtituent part of Bodies, 53, 138
——Origin of unorganical, in Bodies, 55

F

Facts, Syſtematic, explained, --- --- 126
Fluidity neceſſary to the generation and maintenance of heat, --- -- 127
——But not fluidity alone, --- -- 129

G

Generation, abſurd Doctrine of, --- 70
——What, --- --- -- 71
——Diſtinguiſhed from Conception, -- 72

H

Hyſterics, their immediate Source, --- 83
——A Diſeaſe of the Life, --- 84,--91
——Symptoms, proper, --- -- 91
————Improper, --- -- 87
————Cauſes of increaſe of, 97, 116
————Indications of Cure of, 170
Hypochondraic and Hyſteric, confounded, 34
Hypochondraic diſeaſe, its nature, degrees, cauſes and indications of cure, --- 174

I

Infant Mortality increaſed, why, 110, 117
Infection explained, --- -- 138

Irritability,

Irritabillty, --- -- p. 150
———Its cure, -- -- 156
———diſtinguiſhed from Spaſm, 160

L

Life, animal, what, --- --- 44, 51
Life, phyſical and metaphyſical --- 50, 165
Limits of Nature's power, --- 69

M

Mechaniſm, the ſecret ſource of occult qualities, -- -- 44
Matter diſtributed, --- --- 46
Modes of Light's Exiſtence in Bodies, -- 48
Magneſia alba, how ſpoiled, &c. --- 182

N

Nature defined, --- --- 45
Nerves, the directors, but not the ſole tranſmitters of the Principle of Life, --- 94

O

Occult qualities, --- --- --- 43
———Produced by Light, --- --- 47
Oils, a final concoction in natural proceſſes, 54

P

Paracelſus, --- --- 70

R

Revolution in modern Conſtitution, cauſe of encreaſed frequency of Hyſteric and Hypochondriac diſeaſes, --- --- 103

Rouſeau cenſured, -- --- p. 104
Red particles of Blood, their peculiar characters, --- --- 147

S

Solids, not compoſed of Earth, --- 53
Sugar, the principal cauſes of the Revolution in modern conſtitutions, --- -- 3
Serum, its Properties, --- --- 145
Spaſm, --- --- --- 158
———practical rules to diſtinguiſh it from inflammatory pain, -- -- -- 160
———practically diſtinguiſhed from irritability, --- --- --- 164

T

Tachenius, --- --- --- 45
Terreſtrial and Celeſtial matter in the compoſition of every Body, -- -- 46

W

Water, --- --- --- --- 49

V

Viſion, a note upon, --- --- -- 82
Van Helmont, --- --- --- 174

APPENDIX.

REFLECTIONS *on the Nature of* ABSORBENTS *and the Extent of* ABSORPTION.

IN my diſcourſe on the powers employed in the circulation of animal fluids, I have not only taken it for granted, that our venous ſyſtem of veſſels act as abſorbents; but I have even ſuppoſed that the extent and meaſure of their abſorption was much more conſiderable than that of either the lacteals, or of the lymphatics, or indeed of both together. Whatever queſtion there may be of that proportion of abſorption I conjectured belonged to the veins; I never ſuſpected that it could be a queſtion with any, Whether veins did abſorb at all or not? until I was informed that ſome affirmed, that without all queſtion veins did not abſorb.

THIS I think a haſty deciſion; and unleſs it can be uncontravertibly demonſtrated by experiment (for there is no diſputing againſt a matter of fact) I am apt to ſuſpect it is an unphiloſophical one; that is, one not agreeable to the mechanical powers and action of abſorbing veſſels.

IF it was aſked of a Naturaliſt, What is it that conſtitutes a ſyſtem of veſſels abſorbents? I think it is probable that he would anſwer, That their being confluent, or that the direction of the fluid that moved in veſſels being confluent, would be ſufficient to characteriſe ſuch veſſels abſorbents, if they had opportunities of abſorption; that is, if any fluid was offered to them to be abſorbed.

If it could even be proved that veins had no extreme capillary veſſels, but what were continuations of arteries, I do not think that would be ſufficient to determine that veins are not abſorbents; for, in my opinion, veſſels do not abſorb at their extremities only, but at every lateral pore through which a particle of a fluid, or of the effluvia of a fluid, can paſs. It is the ſuction at the trunk, bag, or confluent extremity of a venous or abſorbent ſyſtem of any kind, that is the cauſe of abſorption; and that cauſe acts upon every extremity and every pore, that can poſſibly communicate with the exhauſter acting at the terminating trunk.

Nature ſeems to have a very extenſive, almoſt an unlimited power of forming abſorbents, both in the vegetable and in the animal world. Moſt plants take root, and grow by the ſlip, as well as by the ſeed. Branches of many trees, even ſome inverted, do the ſame. In which caſes it is evident, that even veſſels that were originally neither veins nor abſorbents of any kind, are changed into ſuch. The direction and determination given to the motion of the juices in them is ſufficient to invert them into abſorbents, or into a venous ſyſtem.

In the animal œconomy, even a double venous ſyſtem, generated and eſtabliſhed ſolely upon the principle of abſorption, is ſtill more demonſtrable, in that intercourſe eſtabliſhed between the vegitating infant, and the mother.——I dare ſay, no probable reaſon can be adduced, for preſuming that none of the intercourſe between the arterial and venous ſyſtems can be carried on in the ſame manner.

EVERY venous pore on our external and internal ſurfaces abſorbs; and every pore of our internal ſubſtance either tranſudes or abſorbs. It is impoſſible to aſſign all this abſorption to be diſpatched by the lymphatics only.—— Beſides there are many weighty objections to the ſuppoſition. Spirits intoxicate by the mouth, without being taken into the ſtomach.——Stagnant humours are diſcuſſed; tumours are reſolved; extravaſated pus, and other noxious humours, are abſorbed, and ſometimes depoſited in other places; hectic fevers are often raiſed and fed by abſorption. I do not think it ever was ſuppoſed, or can be ſuppoſed, that all this muſt be done by the medium of the lymphatic ſyſtem; and that all the corruption that is often abſorbed within the body, muſt go the courſe of the lymph, and be filtrated and digeſted in all the glands through which the lymph paſſes. ——The moſt general ſpecies of the aſcitic dropſy, at leaſt in males, has always been imputed to a venous obſtruction in the liver: but if all abſorption could be ſuppoſed lymphatic, then it would neceſſarily give us a new idea of that diſeaſe; which I am afraid, would not be conſonant to obſervation and experience.

I THINK it can ſcarcely be ſuppoſed that when a briſk purge, or efficacious diuretic, acts powerfully, as either will do ſometimes, on either an aſcitic or leucophlegmatic dropſy, that all this ſurpriſing and ſudden revulſion is made by the lymphatics.——It is plain to me, that neither an aſcitis, nor a leucophlegmatia, or anaſarca, are diſeaſes of the lymphatic ſyſtem; but are owing to a debilitated tone of the ſolids in general, which manifeſts its effects primarily in the decaying, abſorbing power of the venous ſyſtem; leaving ſtagnant what they were wont to take up and carry off, without any difficulty.——Can it be ſuppoſed that in a mercurial unction, the mercury has no road for penetrating through the ſyſtem, but by being firſt taken up by, and going the courſe of, the lymphatics?—Theſe are all too much to ſuppoſe, and take for granted, merely for the ſake of reſtricting abſortion to the lymphatics. It is begging the queſtion that ought to be proved.

I AM ſure, that multitudes of extreme terminating arteries are not continuous into veins; and it never has been proved that there are no extreme veins, but what are continuous into arteries. I am ſure, there are no extreme veſſels, nor lateral pores in the veſſels of animals, ſo ſmall as the particles of animal effluvia; and as every point of our internal ſubſtance is irrigated with theſe effluvia, I think I may ſay, I am therefore conſequentially, or logically ſure, that wherever there is in the animal ſyſtem confluent veſſels, theſe muſt be conſtantly abſorbing.

THE END.